West Sacramento GRR EIS/EIR
Appendix A

Final Fish and Wildlife Coordination Act Report

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Suite W-2605
Sacramento, California 95825-1846

In Reply Refer to:
81420-
2009-FA-0502-2

MAY 19 2015

Alicia E. Kirchner
Chief, Planning Division
Corps of Engineers, Sacramento District
1325 J Street
Sacramento, California 95814-2922

Dear Ms. Kirchner:

The U.S. Army Corps of Engineers has requested coordination under the Fish and Wildlife Coordination Act (FWCA) for the West Sacramento Flood Control Project, General Reevaluation Report. The proposed modifications would be along levees surrounding the City of West Sacramento, Yolo County, California. The enclosed report constitutes the U.S. Fish and Wildlife Service's FWCA report for the proposed project.

If you have any questions regarding this report, please contact Harry Kahler at (916) 414-6550.

Sincerely,

Jennifer M. Norris
Field Supervisor

Enclosure

cc:
Bay-Delta FWO, Sacramento, CA
Sarah Ross Arrouzet, COE, Sacramento, CA
Howard Brown, NMFS, Sacramento, CA
Region 3 Manager, CDFW, Napa, CA

FISH AND WILDLIFE COORDINATION ACT REPORT
WEST SACRAMENTO FLOOD CONTROL PROJECT
GENERAL REEVALUATION REPORT
May 7, 2015

This is the U.S. Fish and Wildlife Service's (Service) Fish and Wildlife Coordination Act report on the effects of the proposed West Sacramento Flood Control Project` (WSFCP), General Reevaluation Report (West Sacramento GRR or GRR project), City of West Sacramento, Yolo County, California. This report has been prepared under the authority of, and in accordance with, the provisions of the Fish and Wildlife Coordination Act (48 stat. 401, as amended: 16 U.S.C. 661 et seq.).

BACKGROUND

A series of storms with unusually high levels of precipitation, between December 26, 1996, and January 3, 1997, caused several major flooding events throughout the Sacramento Valley. These events prompted comprehensive studies, which impelled the U.S. Army Corps of Engineers (Corps) to revise levee criteria regarding under-seepage and through-seepage deficiencies. In turn, levees of the WSFCP were evaluated according to the Corps criteria for stability, seepage, erosion, geometry, and levee height. Data collected from the evaluation show that much of the existing system does not provide the City of West Sacramento protection from a 100-year flood event.

In 2006, the Federal Emergency Management Agency initiated the Flood Insurance Rate Map modernization program. Under the program, for properties in a 100-year floodplain, flood insurance would be mandatory with all federally guaranteed loans. Furthermore, California Senate Bill 5, signed into law in October, 2007, by Governor Arnold Schwarzenegger and overseen by the Central Valley Flood Protection Board, requires that urban areas such as the City of West Sacramento achieve 200-year flood level protection by 2025.

The purpose of the West Sacramento GRR is to bring the 50-miles of perimeter levees surrounding the City of West Sacramento into compliance with applicable Federal and State standards for levees protecting urban areas. In four areas with marked levee deficiencies, West Sacramento Area Flood Control Agency (WSAFCA) has sponsored West Sacramento Levee Improvement Program (WSLIP) Early Implementation Projects (EIPs) to make levee improvements in advance of the GRR project. To date, three EIPs have been completed: the I Street Bridge, The Rivers, and California Highway Patrol (CHP) Academy Projects; a fourth EIP, the Southport Project, is currently in final design.

Further, in view of recent community growth, the City of West Sacramento has recreation and open space needs and goals. Surrounding waterways represent not just an element of flood risk, but also provide public open space and opportunities for water-based recreation. Flood protection improvement elements typically underlie or are adjacent to proposed recreation elements that are part of the City of West Sacramento planning documents. Levee crowns, for example, are commonly used as public trails for pedestrians and bicyclists. Therefore, along with flood protection, the Corps has identified open space and recreational goals as part of the GRR project.

Lastly, the levees of WSFCP are part of the Sacramento River Flood Control Project (SRFCP). Concerns exist that the performance of the SRFCP needs to be evaluated comprehensively to ensure

that risk is not being transferred between discrete projects of separate communities. Because West Sacramento is located downstream of many other SRFCP projects, The West Sacramento GRR allows the opportunity to make a comprehensive evaluation of the SRFCP. In combination, the WSLIP EIPs and actions under the GRR project will address levee deficiencies to meet necessary flood protection standards, provide recreational opportunities for the City of West Sacramento, and provide an opportunity to evaluate comprehensively the effectiveness of SRFCP activities.

PROJECT DESCRIPTION

Regardless of alternative, the following measures and policies would be addressed during construction:

- The Corps' standard levee footprint would be established during construction of structural improvements on all levees that are out of compliance. The standard levee footprint consists of a 20-foot-wide crown width, 3:1 waterside and landside slope. If the 3:1 landside slope is not possible based on site specific conditions, then a minimum 2:1 landside slope would be established with supporting engineering analysis.

- A 20-foot-wide landside and waterside maintenance access roads would be established. Where 20 feet cannot be obtained, 10 feet is allowable.

- Compliance with the Corps' Engineering Technical Letter 1110-2-571 vegetation requirements would be enforced. The vegetation requirements include a vegetation-free zone on the levee slopes and crown, 15 feet from both landside and waterside levee toes, and 8 feet vertically. When possible, a variance would be sought to allow vegetation to remain. A variance would allow for vegetation to remain on the lower portion of the waterside slope and within the waterside 15-foot vegetation-free zone.

- Utilities encroachments including structures, certain vegetation, power poles, pump stations, and levee penetrations (e.g., pipes, conduits, cables) would be brought into compliance with applicable Corps policies or removed. This measure would include demolition and relocation or reconstruction as appropriate; or retrofitting to comply with current standards. Utilities replacement would occur via a surface line over the levee prism, or a through-levee line equipped with positive closure devices.

- Private encroachments shall be removed by the non-federal sponsor or property owner prior to construction.

Levee Design Remediation

Where the existing levee cross section does not meet Corps standard levee design requirements, slope flattening and/or crown widening would be required. These improvement measures address problems with slope stability, geometry, and levee toe and crest access for maintenance. Due to the urban nature of the project area, the proximity of development to the levees, and cost, most levee repairs would be fixed in place.

Prior to embankment grading, the area would be cleared, grubbed, and stripped. Where necessary, portions of the existing embankment would be excavated to allow for bench cuts and keyways to tie in additional embankment fill. The existing levee centerline would be shifted landward to meet the Corps' standard levee footprint requirements. Excavated and borrow material would be stockpiled at staging areas. Haul trucks, front end loaders, and scrapers would bring borrow materials from nearby areas to the site, then spread it evenly and compact it according to levee design plans. The levee would be hydroseeded once construction is completed.

Seepage and Slope Stability Remediation

Levees in the project area also require improvements to address seepage, slope stability, overtopping, and erosion. The measures proposed to improve the levees are described below and consist of: seepage cutoff walls, seepage berms, stability berms, slope reshaping, levee raises, flood walls, and bank protection.

Seepage Cutoff Walls

To address seepage concerns, a cutoff wall would be constructed through the levee crown. The cutoff wall would be installed by one of two methods: conventional open trench cutoff walls; or deep soil mixing (DSM) cutoff walls. The method of cutoff wall selected for each reach depends on the depth of the cutoff wall needed to address the seepage. The open trench method can be used to install a cutoff wall to a depth of about 85 feet. For cutoff walls of greater depth, the DSM method used.

Prior to construction of any cutoff wall, the construction site and any staging areas would be cleared, grubbed, and stripped. The levee crown would be degraded to about half the levee height to create a 30-foot-wide working platform and to reduce the risk of hydraulically fracturing the levee embankment from the insertion of slurry fluids. Excavated and borrow material would be stockpiled at staging areas. Haul trucks, front end loaders, and scrapers would bring borrow materials to the site, which would then be spread evenly and compacted according to levee design plans. The levee hydroseeded once construction is completed.

Conventional Open Trench Cutoff Wall

A trench about 3 feet wide would be excavated through the centerline of the levee crown up to 85 feet deep. As the trench is excavated with a long-boom excavator, it would be filled with a low density temporary bentonite water slurry to prevent cave in. The soil from the excavated trench would be mixed nearby with hydrated bentonite, and in some applications, cement. The soil bentonite mixture would be backfilled into the trench, displacing the temporary slurry. Once the slurry has hardened, it is capped and the levee embankment is reconstructed with impervious or semi-impervious soil.

Deep Soil Mixing Cutoff Wall

The DSM method involves a crane supported set of two to four mixing augers used to drill through the levee crown and subsurface to a maximum depth of about 140 feet. As the augers are inserted and withdrawn, a cement bentonite grout would be injected through the augers and mixed with the native soils. An overlapping series of mixed columns would be drilled to create a continuous seepage cutoff barrier. Once the slurry has hardened it is capped and the levee embankment is reconstructed with impervious or semi-impervious soil.

Seepage Berm
In some areas, geotechnical investigations have determined that a seepage berm is more appropriate to address seepage than a cutoff wall. The seepage berm would extend out from the landside levee toe and would vary in width from 60 to 300 feet, tapering down from a 5-foot thickness at the levee, to a 3-foot thickness at the berm toe. The length of the seepage berm depends on the seepage conditions along the levee reach.

Excavated and borrow material would be stockpiled at staging areas. Haul trucks and front end loaders bring borrow materials from staging areas to the site, which would then be spread evenly and compacted according to design plans. The new seepage berm would be hydroseeded after construction.

Stability Berm
A stability berm would be constructed against the landside slope of the existing levee with the purpose of supplying support as a buttress. The height of the stability berm is generally 2/3 of the height of the levee and extends for a distance determined by the structural needs of the levee along that reach. Embankment fill material necessary to construct the berm is excavated by a bulldozer from a nearby borrow site. Front-end loaders load haul trucks with the borrow material and the haul trucks transport the material to the stability berm site. Motor graders spread the material evenly according to design specifications, and a sheepsfoot roller compacts the material. Water trucks distribute water over the material to ensure proper moisture for compaction. The new seepage berm would be hydroseeded after construction.

Setback Levee
Setback levees are proposed for the Sacramento River south levee to address seepage, stability, and erosion concerns. The typical offset distance of the setback levee from the existing levee is about 400 feet. Most of the existing levee would be degraded to an elevation of 30 feet. In the northern section, the existing levee would be breached in two areas for a length of 800 to 1,000 feet. In the southern section, the existing levee would be breached in three areas for a length of about 800 feet.

Sheet Pile Wall
A trench would be excavated along the sheet pile alignment to allow the pile to be driven to the proposed level below the existing levee grade. A driving template fabricated from structural steel would be placed to control the alignment as the sheet pile is installed. A hydraulic or pneumatically operated pile driving head attached to a crane would drive the sheet pile into the levee crown to the desired depth (up to 135 feet). An additional crane or excavator would be used to facilitate staging of the materials. The conditions of the site, driving pressure, hydrostatic loads, and corrosion considerations determines the thickness, configuration, and finish coating of the sheet piles.

Jet Grouting
Jet grouting involves injecting a grout mixture into the soil at very high pressure. Jet grouting breaks up soil and, with the aid of a binder, forms a homogenous mass that solidifies over time to create a mass with low permeability. Jet-grouted columns range from 1 to 16 feet in diameter and typically are interconnected to form cutoff barriers or structural sections. It is typically used as a spot application to address seepage rather than a treatment to be applied on a large scale.

Equipment required for jet grouting consists of a drill rig fitted with a special drill string; a high pressure, high flow pump; and an attached batching plant to supply the grout and water. The spoil

material contains significant grout content and frequently is used as construction fill material. To provide a wide enough working platform on the levee crown, the upper portion of some segments of the levee may require degradation with a paddle wheel scraper. Material is scraped and stockpiled at a nearby stockpile area. Hauling at the work area involves scraper runs along the levee to the staging area and grout, bentonite, and water deliveries to the batch plant.

Relief Wells

Relief wells are passive systems that are constructed near the landside levee toe to provide a low-resistance pathway for under-seepage. The wells bring seepage water to the ground surface in a controlled and observable manner. Relief wells are an option only in segments where geotechnical analyses have identified continuous sand and gravel layers and the presence of an adequate impermeable layer.

Relief wells are generally spaced at 50- to 150-foot intervals, dependent on the amount of under-seepage, and extend to depths of up to 150 feet. A typical well-drilling rig is used to drill to the required depth and construct the well beneath the ground surface. The drill rig likely would be an all-terrain, track-mounted rig that could access the well locations from the levee toe. A relief well is constructed using soil-boring equipment to drill a vertical hole. Pipe casings and gravel/sand filters are installed to allow water to flow freely while preventing levee materials from entering the stream. The water is collected and discharged into a drainage system via ditches or an underground piping system.

Areas along the levee toe may be used to store equipment and supplies during construction of each well. Construction of each well and the lateral drainage system typically takes 10 to 20 days.

Overtopping Remediation

Levee Raises

To address identified height deficiencies, additional borrow material would be added after cutoff walls and levee reshaping improvements are completed. The additional material would be brought from nearby borrow sites, stockpiled in staging areas then hauled to the site with trucks and front end loaders. Material would be spread evenly and compacted according to levee design plans. The levee would be hydroseeded once construction was completed.

Floodwalls

Floodwalls would be used to contain unusually high water surface elevations. Prior to construction, the area would be cleared, grubbed, stripped, and excavated to provide space for constructing the floodwall footing. The floodwall would primarily be constructed from pre-fabricated materials, although it may be cast or constructed in place, and would be constructed almost completely upright. Floodwalls are placed at the waterside hinge point of the levee crown and would be designed to disturb a minimal amount of waterside slope and levee crown. Floodwall heights vary from 1 to 4 feet, as required by water surface elevations. The waterside slope grade would be re-established and a slight downward grade away from the floodwall would be added to the levee crown.

Erosion Remediation

Rock Bank Protection

Bank protection measures consist of waterside armoring of the levees to prevent erosion and subsequent damage to the levee. This measure consists of placing rock revetment on river banks, and in some locations on levee slopes, to prevent erosion. If necessary, the eroded portion of the bank would be filled and compacted prior to rock placement. Pre-construction preparation involves clearing and stripping. In most cases large vegetation would be permitted to remain at these sites. Temporary access ramps would be constructed, if needed, using imported borrow material. The bank protection would be placed at a slope varying from 2:1 to 3:1 depending on site specific conditions.

Revetment would be imported from an offsite location via haul trucks or barges. Revetment transported by haul trucks would be temporarily stored at a staging area adjacent to the construction site. A loader would be used to move revetment from the staging area, and an excavator would place the material onsite. Rock placement from atop the levee would require one excavator and one loader for each potential placement site.

Revetment transported by barges would not be staged, but placed directly on site by an excavator located on the barge. The excavator would construct a large rock berm in the water up to an elevation just above the mean summer water surface. A planting trench would be established on this rock surface for revegetation. Construction would require two barges: one barge would carry the excavator, while the other barge would hold the stockpile of rock to be placed on the channel slopes.

Biotechnical Bank Protection

Biotechnical measures have been proposed to protect several levee reaches. Biotechnical protection would be considered for lower velocity reaches to preserve existing vegetation. Under this measure, the Corps would use plant material and minimal amounts of rock to stabilize the eroded slope and prevent further loss of material.

Project Alternatives

The WFSCP involves over 50 miles of levees surrounding the City of West Sacramento (Figure 1). The Port of West Sacramento and the barge canal that flows from the Sacramento River into the Deep Water Ship Channel (DWSC), divides the City of West Sacramento into two sections – the north and south basin. The south basin contains about 6,900 acres, while the north basin contains about 6,100 acres. Levees of the WSFCP encircle each basin (Table 1).

No Action Alternative

A No Action Alternative is required pursuant to NEPA, and a no project alternative is required for CEQA. For this report, it will be referred to as the No Action Alternative. The No Action Alternative serves as a benchmark against which the effects and benefits of the action alternatives are evaluated. The No Action Alternative assumes that current conditions and operation and maintenance practices would continue in the foreseeable future if the project were not implemented, based on current plans and consistent with available infrastructure and community services.

Figure 1. West Sacramento Flood Control Project Features, Yolo County, California, 2015.

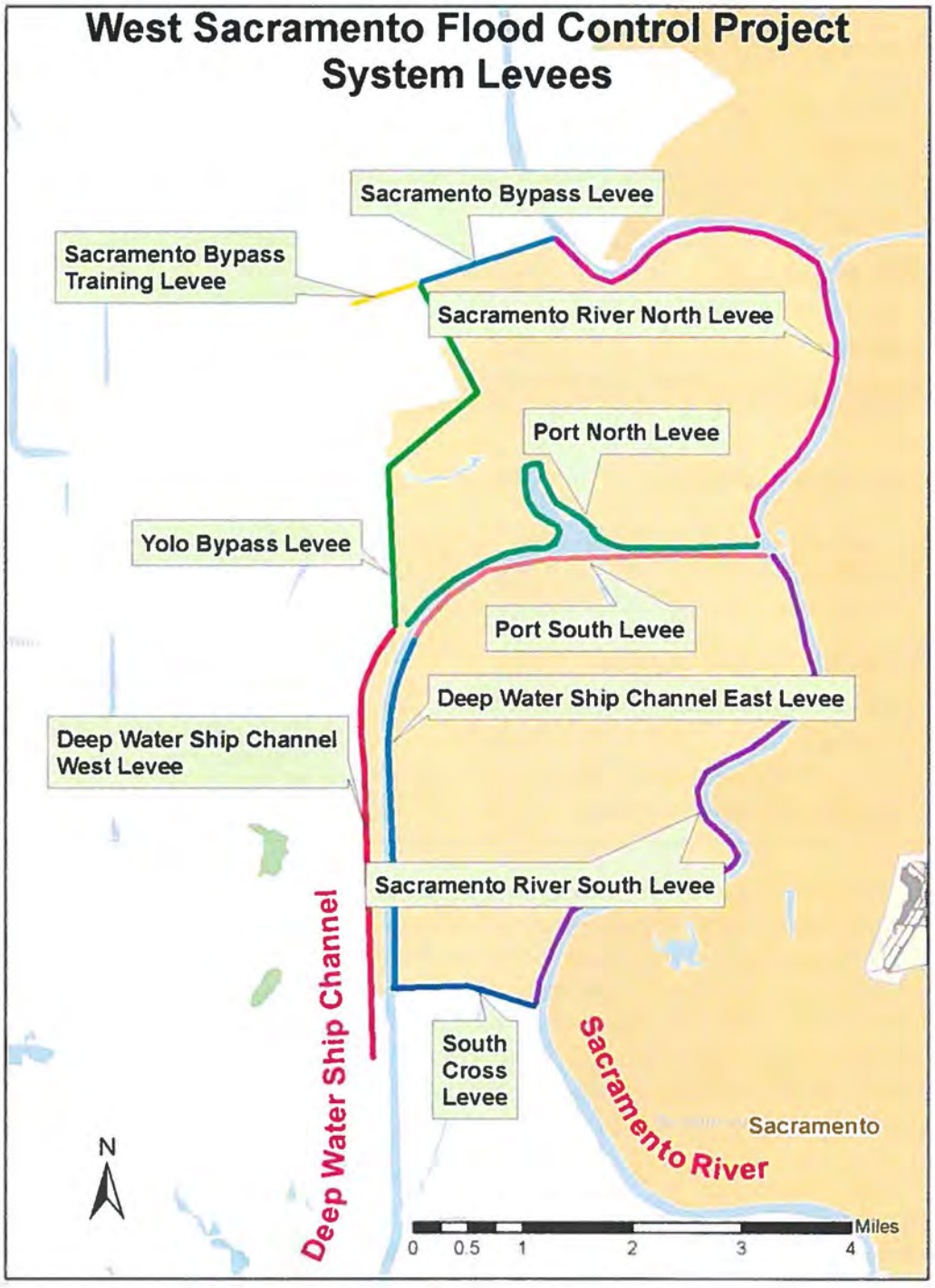

Table 1. West Sacramento Flood Control Report Project levees surrounding the north and south basins of West Sacramento, Yolo County, California.

Levee Reach Name	Length (miles)	Reach
North Basin Levees		
Sacramento River north levee	5.5	Along the Sacramento River south from the Sacramento Bypass to the William Stone Lock building at the barge canal
Port north levee	4.9	William Stone Lock building west to the Yolo Bypass
Yolo Bypass levee	3.7	Port north levee north to the Sacramento Bypass
Sacramento Bypass levee	1.1	Yolo Bypass levee east to the Sacramento River
Training levee	0.5	West spur beyond the Yolo Bypass levee along the Sacramento Bypass
South Basin Levees		
Sacramento River south levee	5.9	Along the Sacramento River from the William Stone Lock structure at the barge canal south to the South Cross levee
South Cross levee	1.2	Sacramento River west to the Deep Water Ship Channel
Deep Water Ship Channel east levee	2.8	South Cross levee north to the eastward bend southwest of the Port of Sacramento
Port south levee	4.0	East from the eastward bend to the William Stone Lock structure
Deep Water Ship Channel west levee	21.4	Port north levee south to Miner's Slough

Under the No Action Alternative, the Corps would not conduct any additional work to address seepage, slope stability, overtopping, geometry, or erosion concerns in the West Sacramento area. As a result, if a high-water event were to occur, the West Sacramento area would remain at risk of a possible levee failure. The levees protecting the city would continue to require improvements to meet FEMA's minimum acceptable level of flood protection. In addition, the associated risk to human health and safety, property, and the adverse economic impact that serious flooding could cause would continue, and the risk of a catastrophic flood would remain high. Regular operations and maintenance of the levee system would continue as presently executed by the local maintaining entities.

Alternative 1 – Fix Levees

Alternative 1 would include the construction of levee remediation measures to address: seepage, slope stability, erosion, geometry, vegetation, and overtopping concerns identified for the Sacramento River, South Cross, DWSC, Port, Yolo Bypass, and Sacramento Bypass Training levees (Appendix A, pg. A1).

Due to environmental, real estate, and hydraulic constraints within the West Sacramento North Basin, Alternative 1 proposes fix-in-place remediation. For the South Basin, fix-in-place remediation and seepage berms are proposed. A berm is proposed for the South Basin where a cutoff wall does not completely remove the through- and underseepage threat. The purpose of this alternative would be to improve the flood damage reduction system to safely convey flows to a level that maximizes net benefits. Table 2 summarizes the levee remediation measure for each reach in each basin.

Table 2. Alternative 1 – Proposed Remediation Measures by Levee Reach.

Levee Reach	Seepage Measures	Stability Measures	Overtopping Measures	Erosion Protection Measures
Sacramento River north	Cutoff Wall	Cutoff Wall	Levee Raise	Bank Protection
Port north*	—	—	Flood Wall	—
Yolo Bypass *	Cutoff Wall	Cutoff Wall	—	—
Sacramento Bypass Training levee	—	—	—	Bank Protection
Sacramento River south	Cutoff Wall, Seepage Berm	Cutoff Wall, Stability Berm	—	Bank Protection
South Cross	Cutoff Wall, Seepage Berm	—	Levee Raise	—
Deep Water Ship Channel east *	Cutoff Wall	Cutoff Wall	Levee Raise	—
Deep Water Ship Channel west*	Cutoff Wall, Seepage Berm	Cutoff Wall	Levee Raise	Bank Protection
Port south*	Cutoff Wall	Cutoff Wall	Levee Raise	—

* Only site-specific sections of the levee reach require remediation.

The following sections describe the specific measures proposed under this alternative for the reaches within the West Sacramento North and South Basins.

West Sacramento North Basin

Sacramento River North Levee-

The Sacramento River north levee does not meet design requirements due to several deficiencies. The measures that would be implemented under Alternative 1 for this levee include: installation of cutoff walls to address seepage and stability concerns; levee raises to address inadequate levee height; and bank protection measures to address erosion concerns. Levee embankment grading, height improvements, and bank protection would be constructed to current Corps standards.

Construction of Alternative 1 would take about 12 years. Construction is expected to take 2 years at each levee reach, yet work may be done concurrently on multiple reaches in any given year. Work along the Sacramento River north and Sacramento River south levee reaches are scheduled first for construction. The construction sequence has been prioritized based on current levee conditions, risk assessments, and construction feasibility considerations.

The Sacramento River north levee has a 20-foot-wide levee crown with 3:1 side slopes. A cutoff wall would be constructed through the levee crown. The conventional open trench method would be used to install a cutoff wall to a depth of about 85 feet and the DSM method would be used to install cutoff walls at depths of more than 85 feet.

Additionally, under Alternative 1 a levee would be constructed at the south end of the Sacramento River north levee reach to close the connection between the Sacramento River and the DWSC. The new levee would connect the existing levees along the Sacramento River between the North Basin and South Basin. Along with the proposed new levee reach, a coffer dam would be constructed on the river side between the north and south basins. The new levee would include a cutoff wall or seepage berm. Construction of the new levee may also include installation of a sheet pile wall.

Port North Levee-
The primary issue with the Port north levee is overtopping concerns. Under Alternative 1, a floodwall is proposed to address overtopping. The height of the floodwall varies from 1 to 4 feet.

Yolo Bypass Levee-
Seepage and stability deficiencies were identified at various locations along the Yolo Bypass levee. To address these deficiencies open trench cutoff walls would be installed. Following construction of the cutoff wall, the levee would be rebuilt to current Corps standards.

Sacramento Bypass Levee-
Work completed by the local sponsors has addressed seepage and stability concerns along the Sacramento Bypass levee adjacent to the CHP Academy. This work is not eligible for Federal credit and is included within the No Action Alternative.

Sacramento Bypass Training Levee-
Unlike the Sacramento Bypass levee adjacent to the CHP Academy, the training levee that extends westward into the Yolo Bypass has not been repaired and still has erosion deficiencies. Under Alternative 1, bank protection is proposed to address the erosion concerns.

<u>West Sacramento South Basin</u>
In the South Basin, measures that would be implemented include: installation of cutoff walls or seepage berms to address seepage and stability concerns; stability berms to address stability concerns; levee raises to address height concerns; and bank protection to address erosion concerns.

Sacramento River Levee-
The Sacramento River south levee measures that would be implemented include: installation of cutoff walls and seepage berms to address seepage and stability concerns; stability berms to address stability concerns; and bank protection to address erosion concerns.

As with the Sacramento River north levee, a cutoff wall would be constructed through the levee crown to address seepage concerns. Seepage berms would be constructed in areas where geotechnical investigations show that a berm would be more appropriate.

South Cross Levee-
The measures that would be implemented for the South Cross levee include the installation of cutoff walls or seepage berms to address seepage concerns, and levee raises to address height issues.

Deep Water Ship Channel East Levee-
Remediation measures that would be implemented for the DWSC east levee include cutoff walls to address seepage and stability concerns and raise levees to address height concerns. A conventional open trench cutoff wall would address the seepage and stability problems. The irrigation ditch at the levee toe would be relocated outside the levee footprint south of the area of adjacent housing along Southport Parkway. The irrigation ditch would be replaced with two 48 inch diameter pipes along the levee reach adjacent to the housing development.

Deep Water Ship Channel West Levee-
The DWSC west levee measures to be implemented under Alternative 1 would include: installation of cutoff walls and seepage berms to address seepage concerns; a levee raise to address height concerns; and bank protection to address erosion concerns. A conventional open trench cutoff wall would be constructed to address the seepage and stability concerns at various locations from the South Cross levee south to Prospect Island. In addition, to address erosion concerns, bank protection would be placed along the Yolo Bypass side of the levee at identified locations.

Port South Levee-
Measures that would be implemented for the Port south levee include to installing cutoff walls to address seepage and stability concerns, and raising the levee to address inadequate levee height.

Alternative 2 – Fix Levees and Widen Sacramento Weir and Bypass
Alternative 2 levee improvements are essentially the same as those discussed as Alternative 1, except that the Sacramento Weir and Bypass would be widened to divert more flow into the Yolo Bypass. Subsequently, widening the Sacramento Weir and Bypass decreases the need for many levee raises proposed along the Sacramento River (Appendix A, pg. A2). Alternative 2 levee remediation measures are summarized in Table 3. As with Alternative 1, the construction for all levee reaches is expected to take 12 years.

<u>West Sacramento North Basin</u>
The primary issues identified in the North Basin are erosion, seepage and stability, and minimal levee height concerns. The measures that are implemented under Alternative 2 for the levees in the North Basin would be slope protection, installation of cutoff walls, levee raises, and widening the Sacramento Weir and Bypass to reduce height concerns and provide resiliency. Except for the alterations to the Sacramento Weir and Bypass in the Sacramento River North levee reach, levee remediation measures under Alternative 2 are the same in the North Basin as those proposed under Alternative 1.

Sacramento River North-
The main purpose of the Sacramento Weir is to protect the City of Sacramento from excessive flood stages in the Sacramento River channel downstream of the American River. Because the design flood capacity of the American River is 5,000 cubic feet per second higher than that of the Sacramento River downstream of the confluence, flows during a major flood event often exceed the capacity of the Sacramento River. The Sacramento Weir is designed to accept excessive flows during such flood events.

Table 3. Alternative 2 – Proposed Remediation Measures by Levee Reach.

Levee Reach	Seepage Measures	Stability Measures	Overtopping Measures	Erosion Protection Measures
North Basin				
Sacramento River north	Cutoff Wall	Cutoff Wall	Sacramento Weir/Bypass Widening, Levee Raise	Bank Protection
Port north*	---	---	Flood Wall	---
Yolo Bypass*	Cutoff Wall	Cutoff Wall	---	---
Sacramento Bypass Training levee	---	---	---	Bank Protection
South Basin				
Sacramento River south	Cutoff Wall, Seepage Berm	Cutoff Wall, Stability Berm	---	Bank Protection
South Cross	Cutoff Wall, Seepage Berm	---	Levee Raise	---
Deep Water Ship Channel east*	Cutoff Wall	Cutoff Wall	Levee Raise	---
Deep Water Ship Channel west*	Cutoff Wall, Seepage Berm	Cutoff Wall	Levee Raise	Bank Protection
Port south*	Cutoff Wall	Cutoff Wall	Levee Raise	---

* Only site-specific sections of the levee reach require remediation.

Under Alternative 2, the Sacramento Weir and Bypass would be expanded to roughly twice their current width to accommodate increased bypass flows. The existing north levee of the Sacramento Bypass would be degraded and a new north levee would be constructed about 1,500 feet to the north. The Sacramento Weir would be lengthened across the bypass width accordingly. The new north levee slopes would be flattened to 3:1 and includes a new road on the landside, a 300-foot-wide seepage berm, and a system of relief wells. Agricultural ditches/canals on the landside of the existing levee would be filled and relocated along with the pump station(s) to maintain the existing operation.

Widening the Sacramento Bypass as proposed reduces the need for height improvements along the Sacramento North levee reach. Measures proposed under Alternative 1 that would be implemented under Alternative 2 include the installation of cutoff walls, and bank protection measures.

West Sacramento South Basin

The primary issues in the South Basin are also erosion, seepage and stability, and inadequate levee height. The measures that would be implemented under Alternative 2 are the same as for Alternative 1, except for along the Sacramento River south levee.

Sacramento River South-
As with the Sacramento River north levee, there is a reduced need to address the levee height issues along the South Basin due to the widening of the Sacramento Weir and Bypass. The widening of the Sacramento Bypass reduces the extent of height improvements necessary, but does not eliminate them. Measures that would be implemented under Alternative 2 for the Sacramento River south levee include: installation of cutoff walls, seepage berms, and stability berms; levee raises; and bank protection measures.

Alternative 3 – Fix Levees and Deep Water Ship Channel Closure Structure
Alternative 3 would include all of the levee improvements discussed in Alternative 1, except that a DWSC closure structure would preclude repairs on the Port north, Port south, and portions of the DWSC east and west levees (Appendix A, pg. A3). As with Alternative 1, the Sacramento River, Yolo Bypass, and South Cross levees would be improved to address seepage, stability, erosion, and height concerns. The levee remediation measures proposed under Alternative 3 are summarized in Table 4.

Table 4. Alternative 3 – Proposed Remediation Measures by Levee Reach.

Levee Reach	Seepage Measures	Stability Measures	Overtopping Measures	Erosion Protection Measures
North Basin				
Sacramento River north	Cutoff Wall	Cutoff Wall	Levee Raise	Bank Protection
Port north*	Closure Structure	Closure Structure	Closure Structure	Closure Structure
Yolo Bypass *	Cutoff Wall	Cutoff Wall	—	—
Sacramento Bypass Training levee	—	—	—	Bank Protection
South Basin				
Sacramento River south	Cutoff Wall	Cutoff Wall, Stability Berm	—	Bank Protection
South Cross	Cutoff Wall, Seepage Berm	—	Levee Raise	—
Deep Water Ship Channel east *	Cutoff Wall	Cutoff Wall	Levee Raise	—
Deep Water Ship Channel west*	Cutoff Wall, Closure Structure	Cutoff Wall, Closure Structure	Levee Raise, Closure Structure	Bank Protection
Port south*	Closure Structure	Closure Structure	Closure Structure	Closure Structure

* Only site-specific sections of the levee reach require remediation.

Regardless of the measure implemented for the alternative, the levee would be brought into compliance with Corps levee design criteria. To provide for levee construction, inspection, maintenance, monitoring, and flood-fighting access, some properties may need to be acquired.

West Sacramento North Basin
Measures that would be implemented for the levees in the North Basin are: installation of cutoff walls to address seepage and stability concerns; levee raises to address height concerns; constructing the DWSC closure structure to address seepage, stability, height, and erosion concerns; and erosion protection to address erosion concerns.

Levees along the Yolo Bypass, Sacramento Bypass, and Sacramento River north reaches would be remediated as described under Alternative 1.

Port North Levee-
The primary issue in the Port north area is overtopping concerns, putting in the DWSC closure structure would eliminate the need to construct floodwalls.

West Sacramento South Basin
Measures that would be implemented for the levees in the South Basin are: installation of cutoff walls or seepage berms to address seepage and stability concerns; levee raises to address height concerns; erosion protection to address erosion concerns; and construction of the DWSC closure structure to address seepage, stability, height, and erosion concerns.

Levees along the Sacramento River south and South Cross levee reaches would be remediated as described under Alternative 1.

Deep Water Ship Channel Closure Structure-
Under Alternative 3, a flood barrier structure would be constructed within the Sacramento DWSC to prevent flood flows from proceeding north in the ship channel. The closure structure would be constructed in three stages using a separate steel sheet pile cofferdam at each stage.

The first stage would require the construction of a cofferdam on the east side of the DWSC that would allow ship traffic to continue to the Port during first stage construction. The first stage cofferdam would be removed upon completion of the first stage structure. The second stage of construction would be similar to the first stage construction, but at the western edge of the DWSC. The second stage cofferdam would be removed upon completion of the second stage structure. The third stage of construction would be to install a cofferdam between the first and second stage structures. Sector gates would be installed during the third stage so that, when closed, the Port and surrounding areas can be protected during flood events. The gates would remain open for normal Port traffic upon completion of the third stage.

Deep Water Ship Channel East Levee-
Generally, the Alternative 3 remediation measures for the DWSC east levee are consistent with Alternative 1. However, under Alternative 3 these levee improvements only occur from the closure structure south to the South Cross levee. The closure structure prevents water from flowing north into the Port of West Sacramento, thus eliminating the need to improve the levee north of the structure.

Deep Water Ship Channel West Levee-
As with the DWSC east levee, Alternative 3 measures for the DWSC west levee are consistent with Alternative 1, with a few exceptions. Under Alternative 3, there is no need for remedial construction along the west levee north of the closure structure.

Port South Levee-
The primary issues in the Port south area are overtopping, seepage, and stability. These issues are addressed with the implementation of the closure structure.

Alternative 4 – Fix in Place, Sacramento Bypass Widening, and DWSC Closure Structure
Alternative 4 includes the levee improvements discussed in Alternative 1, but with the Sacramento Bypass widening discussed in Alternative 2 and the DWSC closure structure discussed in Alternative 3 (Appendix A, pg. A4). The widening of the Sacramento Weir and Bypass diverts more flow into the Yolo Bypass, decreasing the need to raise levees along the Sacramento River. Levee repairs on the Port north and Port south levees and northern portions of the DWSC east and west levees are precluded by the construction of the closure structure in the DWSC. The levee remediation measures proposed under Alternative 4 are summarized in Table 5.

Once a levee is modified, regardless of the measure implemented for the alternative, the levee would be brought into compliance with Corps levee design criteria. To provide for levee construction, inspection, maintenance, monitoring, and flood-fighting access, some properties may need to be acquired.

West Sacramento North Basin
Measures that would be implemented for the levees in the North Basin are: installation of cutoff walls to address seepage and stability concerns; levee raises to address height concerns; widening the Sacramento Weir and Bypass to address height concerns and provide resiliency; constructing the DWSC closure structure to address seepage, stability, height, and erosion concerns; and erosion protection to address erosion concerns.

Sacramento River North Levee-
Along the Sacramento River, the measures for the Sacramento Weir and Bypass are consistent with Alternative 2. Under Alternative 2 the Sacramento Weir and Bypass would be widened up to 1,500 feet to accommodate greater flows from the American River during flood events. Other areas of the Sacramento north levee reach are remediated as described in Alternative 1.

Port North Levee-
The primary issue in the Port north area is overtopping. Construction of the DWSC closure structure eliminates the need to construct floodwalls in this reach. The closure structure would be constructed as described in Alternative 3.

Yolo Bypass Levee-
The measures for the Yolo Bypass levee are consistent with Alternative 1. Measures that would be implemented involve the installation of a cutoff wall to address seepage and stability concerns.

Sacramento Bypass Training Levee-
The measures for the Training levee would be consistent with Alternative 1 (bank protection).

Table 5. Alternative 4 – Proposed Remediation Measures by Levee Reach.

Levee Reach	Seepage Measures	Stability Measures	Overtopping Measures	Erosion Protection Measures
North Basin				
Sacramento River north	Cutoff Wall	Cutoff Wall	Sacramento Weir/Bypass Widening	Bank Protection
Port north	Closure Structure	Closure Structure	Closure Structure	Closure Structure
Yolo Bypass *	Cutoff Wall	Cutoff Wall	—	—
Sacramento Bypass Training levee	—	—	—	Bank Protection
South Basin				
Sacramento River south	Cutoff Wall	Cutoff Wall, Seepage Berm	—	Bank Protection
South Cross	Cutoff Wall, Seepage Berm	—	Levee Raise	—
Deep Water Ship Channel east *	Cutoff Wall	Cutoff Wall	Levee Raise	—
Deep Water Ship Channel west	Cutoff Wall, Closure Structure	Cutoff Wall, Closure Structure	Levee Raise, Closure Structure	Bank Protection
Port south	Closure Structure	Closure Structure	Closure Structure	Closure Structure

* Only site-specific sections of the levee reach require remediation.

West Sacramento South Basin

Measures that would be implemented for the levees in the South Basin include: installation of cutoff walls or seepage berms to address seepage and stability concerns; levee raises to address height concerns; widening the Sacramento Weir and Bypass; constructing the DWSC closure structure; and erosion protection to address erosion concerns.

Sacramento River South Levee-

Measures for the Sacramento River south levee are consistent with Alternative 2. Measures that would be implemented for the Sacramento River south levee include: installation of cutoff walls, stability berms or seepage berms to address seepage and stability concerns; levee raises to address height concerns; bank protection measures to address erosion concerns; and Sacramento Weir and Bypass widening to address height concerns and provide system resiliency.

South Cross Levee-

Alternative 4 remediation measures for the South Cross levee are consistent with Alternative 1. Measures that would be implemented for the South Cross levees include the installation of cutoff walls or seepage berms to address seepage and stability concerns, and levee raises to address height concerns.

Deep Water Ship Channel East Levee-
The measures for the DWSC east levee are consistent with Alternative 3 and include the DWSC closure structure. Measures that would be implemented for the DWSC east levee are: installation of cutoff walls to address seepage and stability concerns; levee raises to address inadequate levee height, and the DWSC closure structure to address seepage, stability, and height concerns north of the closure structure.

Deep Water Ship Channel West Levee-
The measures for the DWSC west levee are consistent with Alternative 3. Measures that would be implemented for the DWSC west levee are: installation of cutoff walls to address seepage and stability concerns; a levee raise to address inadequate levee height; the DWSC closure structure to address seepage, stability, and height concerns; and bank protection to address erosion concerns. A seepage berm is not be necessary downstream of the South Cross levee due to the construction of the closure structure.

Port South Levee-
The measures for the Port south levee are consistent with Alternative 3. Constructing the DWSC closure structure provides protection and eliminates the need to construct levee remedial measures north of the closure structure.

Alternative 5 – Fix in Place, Setback Levee, Sacramento Bypass Widening, and DWSC Closure Structure (Locally Preferred Plan)
Alternative 5, the locally preferred plan, includes the levee improvements discussed in Alternative 1, but with the Sacramento Bypass widening discussed in Alternative 2, the DWSC closure structure discussed in Alternative 3, and a setback levee configuration along the Sacramento River south levee (Appendix A, pg. A5). Instead of the fix-in-place repair along the entire reach, levee repairs include adjacent levees and the construction of new setback levees in the South Basin along the Sacramento River. To provide for levee construction, inspection, maintenance, monitoring, and flood-fighting access, some properties may need to be acquired. Levee remediation measures proposed under Alternative 5 are summarized in Table 6.

Remediation along the Sacramento River south levee has been planned as an EIP of the West Sacramento GRR project, known as the Southport Project. As an EIP of the preferred plan, the Southport Project has been planned in greater detail than the other components of the West Sacramento GRR. As such, the Corps has coordinated with the Service under the authority of the Fish and Wildlife Coordination Act to consider the construction alternatives for the Southport Project (Service File #08ESMF00-2013-CPA-0007-2). Given the early implementation projects that have already been constructed, it is estimated that construction activities could be completed by 2025 assuming levee reach designs and construction activities are occuring concurrently.

<u>West Sacramento North Basin</u>
Measures that would be implemented for the levees in the North Basin include: installation of cutoff walls to address seepage and stability concerns; levee raises to address height concerns; erosion protection to address erosion concerns; widening the Sacramento Weir and Bypass to address height concerns and provide resiliency to the region; and constructing the DWSC closure structure to address seepage, stability, height and erosion concerns.

Table 6. Alternative 5 - Proposed Remediation Measures by Levee Reach.

Levee Reach	Seepage Measures	Stability Measures	Overtopping Measures	Erosion Protection Measures
North Basin				
Sacramento River north	Cutoff Wall	Cutoff Wall	Sac Weir/ Bypass Widening	Bank Protection
Port north	Closure Structure	Closure Structure	Closure Structure	Closure Structure
Yolo Bypass *	Cutoff Wall	Cutoff Wall	—	—
Sacramento Bypass Training levee	—	—	—	Bank Protection
South Basin				
Sacramento River south	Setback Levee, Cutoff Wall, Seepage Berm,	Setback Levee, Cutoff Wall, Seepage Berm	—	Setback Levee, Bank Protection
South Cross	Cutoff Wall, Seepage Berm	—	Levee Raise	—
Deep Water Ship Channel east *	Cutoff Wall, Closure Structure	Cutoff Wall, Closure Structure	Levee Raise, Closure Structure	Bank Protection
Deep Water Ship Channel west*	Cutoff Wall, Closure Structure	Cutoff Wall, Closure Structure	Levee Raise, Closure Structure	—
Port south	Closure Structure	Closure Structure	Closure Structure	Closure Structure

* The entire levee reach does not need remediation, only specific sections.

Sacramento Weir and Bypass-
The measures for the Sacramento Weir and Bypass are consistent with Alternative 2. The Sacramento Weir and Bypass would be widened up to 1,500 feet to address height concerns and provide system resiliency.

Sacramento Bypass Training Levee-
The measures for the Training levee are consistent with Alternative 1 (bank protection).

Sacramento River North Levee-
The measures for the Sacramento River north levee are consistent with Alternative 2. Under Alternative 2, Sacramento River levee remediation measures were proposed to address seepage, stability, and erosion control. The measures that would be implemented for the Sacramento River north levee are: installation of cutoff walls to address seepage and stability concerns; a levee raise to address inadequate levee height; and bank protection measures to address erosion concerns.

Port North Levee-
The primary issue in the Port north area is overtopping. As with Alternative 3, construction of the DWSC closure structure eliminates the need to construct floodwalls in this reach.

Yolo Bypass Levee-
The measures for the Yolo Bypass levee are consistent with Alternative 1. Along the Yolo Bypass seepage and stability problems exist at various locations. Remediation measures include the installation of a cutoff wall to address seepage and stability concerns using the conventional open trench cutoff wall method.

West Sacramento South Basin
The measures that would be implemented for the levees in the South Basin include: installation of cutoff walls, stability berms, seepage berms, or setback levees to address seepage and stability concerns; levee raises to address height concerns; erosion protection to address erosion concerns; widening the Sacramento Weir and Bypass to address height concerns and provide system resiliency; and constructing the DWSC closure structure to address seepage, stability, height, and erosion concerns.

Sacramento River South Levee-
Plans for the Sacramento River South Levee include the Southport Project, which is discussed in greater detail in Service file# 08ESMF00-2013-CPA-0007-2. A setback levee would be constructed to address seepage, stability, and erosion. The measures that would be implemented for the Sacramento River south levee include: construction of a setback levee, adjacent levee, seepage berm and fix in place to address seepage, stability, and erosion concerns; installation of cutoff walls, sheet pile walls, jet grouting, and relief wells to address seepage and stability concerns; and bank protection measures to address erosion concerns.

The setback levees would be constructed between River Mile (RM) 57.00 and RM 52.75, separated by Bees Lake. The existing levee at Bees Lake would not be degraded, and flow through Bees Lake would be prohibited by road embankments on each end. The north setback levee is just over a mile long, extending from about RM 56.8 to RM 55.7. The south setback levee is just over 2 miles long, extending from about RM 55.1 to RM 52.8. The typical distance of the setback levee from the existing levee is about 400 feet. Most of the existing levee would be degraded to an elevation of 30 feet. Where necessary, bank protection would be added to the existing levee to protect the bank in place. In the north setback area, there are two locations where the existing levee would be completely degraded to original ground for a length of 800 to 1,000 feet. In the south setback area, there are three locations where the existing levee would be completely degraded to original ground for a length of about 800 feet. Generally, both offset areas are degraded about 10 feet. The complete degrades require bank protection upstream and downstream to prevent erosion during high flows.

South Cross Levee-
The measures for the South Cross levee are consistent with Alternative 1. The remediation measures that would be implemented for the South Cross levee include: installation of cutoff walls or seepage berms to address seepage and stability concerns and levee raises to address levee height concerns.

Deep Water Ship Channel East Levee-
The measures for the DWSC east levee are consistent with Alternative 3 and include the DWSC closure structure. Remediation measures would address seepage, stability, geometry, and height deficiencies. The measures that would be implemented for the DWSC east levee are: installation of cutoff walls to address seepage and stability concerns; a levee raise to address height concerns; and the DWSC closure structure to address seepage, stability, height, and erosion concerns. A cutoff wall and height improvements would be constructed north of the closure structure. The cutoff wall, seepage berm, and height improvements would be constructed from the closure structure south to the South Cross levee. The DWSC closure structure eliminates the need to improve the levees north of its location.

Deep Water Ship Channel West Levee-
The measures for the DWSC west levee are consistent with Alternative 3. The measures that would be implemented for the DWSC west levee are: installation of cutoff walls to address seepage and stability concerns; a levee raise to address height concerns; closure structure to address seepage, stability and height concerns and bank protection to address erosion. A cutoff wall, height improvements, and bank protection would be constructed north of the DWSC closure structure as described under Alternative 1. The cutoff wall, seepage berm, height improvements, and bank protection would not be constructed south of the closure structure.

Port South Levee-
The overtopping, seepage, and stability issues are addressed with the DWSC closure structure. Constructing the DWSC closure structure, as described under Alternative 3, eliminates the need to implement the measures discussed in Alternative 1.

MITIGATION POLICY AND RESOURCE CATEGORY DETERMINATION

The recommendations provided herein for the protection of fish and wildlife resources are in accordance with the Service's Mitigation Policy as published in the Federal Register (46:15; January 23, 1981).

The Mitigation Policy provides Service personnel with guidance in making recommendations to protect or conserve fish and wildlife resources. The policy helps ensure consistent and effective Service recommendations, while allowing agencies and developers to anticipate Service recommendations and plan early for mitigation needs. The intent of the policy is to ensure protection and conservation of the most important and valuable fish and wildlife resources, while allowing reasonable and balanced use of the Nation's natural resources.

Under the Mitigation Policy, resources are assigned to one of four distinct Resource Categories, each having a mitigation planning goal which is consistent with the fish and wildlife values involved. The Resource Categories cover a range of habitat values, from those considered to be unique and irreplaceable, to those believed to be much more common and of relatively lesser value to fish and wildlife. However, the Mitigation Policy does not apply to threatened and endangered species, Service recommendations for completed federal projects or projects permitted or licensed prior to enactment of Service authorities, or Service recommendations related to the enhancement of fish and wildlife resources.

In applying the Mitigation Policy during an impact assessment, the Service first identifies each specific habitat or cover-type that may be impacted by the project. Evaluation species which utilize each habitat or cover-type are then selected for Resource Category analysis. Selection of evaluation species can be based on several rationale, as follows: (1) species known to be sensitive to specific land- and water-use actions; (2) species that play a key role in nutrient cycling or energy flow; (3) species that utilize a common environmental resource; or (4) species that are associated with Important Resource Problems, such as anadromous fish and migratory birds, as designated by the Director or Regional Directors of the Service. (Note: Evaluation species used for Resource Category determinations may or may not be the same evaluation species used in a Habitat Evaluation Procedures application, if one is conducted.) Based on the relative importance of each specific habitat to its selected evaluation species, and the habitat's relative abundance, the appropriate Resource Category and associated mitigation planning goal are determined.

Mitigation planning goals range from "no loss of existing habitat" (i.e., resource category 1) to "minimize loss of habitat value" (i.e., Resource Category 4). The planning goal of Resource Category 2 is "no net loss of in-kind habitat value"; to achieve this goal, any unavoidable losses would need to be replaced in-kind. "In-kind replacement" means providing or managing substitute resources that are physically and biologically the same or closely approximate those lost.

In addition to mitigation planning goals based on habitat values, Region 8 of the Service, which includes California, has a mitigation planning goal of no net loss of acreage for wetland habitat. This goal is applied in all impact analyses.

Thirteen cover-types were identified by the Corps for the GRR Project in the project area. The 13 land cover-types identified in the project area have been merged into 9 categories in this report (Table 7). The evaluation species, resource categories, and mitigation planning goals for the nine cover-types that are possibly impacted by the project are summarized in Table 8.

Two evaluation species were selected for the "Riparian scrub/woodland" cover-type. The riparian scrub/woodland cover-type exhibits a variety of characteristics that can support many species in multiple ways. For example, downy woodpeckers will use snags (i.e., dead or dying trees) for breeding and cover (Schroeder 1982a), and yellow warblers will use dense riparian cover for breeding and feeding (Schroeder 1982b). Historically, upland woodland cover has been decreasing in acreage as human populations increase throughout the Central Valley of California (Katibah 1984). The Service designates the "Riparian scrub/woodland" cover-type in the West Sacramento GRR project area as Resource Category 2 with a mitigation planning goal of "no net loss of habitat value or acreage."

Similarly, the downy woodpecker and wild turkey were chosen as evaluation species for the "Upland woodland" cover-type. As in the "Riparian scrub/woodland" cover-type, downy woodpeckers may use over mature, senescent trees for breeding and feeding. Habitat components important to the wild turkey include the distance between open savannah and tree cover, the amount of herbaceous cover under a tree canopy, and the amount of mast (e.g., acorns) produced by the woodland (Schroeder 1985). These characteristics emphasize the value of upland woodland as habitat for breeding, feeding, and cover from predation. As with riparian woodland cover, upland woodland

Table 7. Summary of cover-types and acreages directly impacted by all alternatives considered in the West Sacramento Flood Control Project GRR, Yolo County, California.

Cover-Types	U.S. Army Corps of Engineers Land Cover-Types	Project Acreage
Riparian scrub/woodland	Valley foothill riparian woodland	239
Upland woodland	Woodlands and forest	16
Emergent wetland	Emergent wetland	86
Seasonal wetland	Seasonal wetland	0.3
Shallow water riverine	Open Water (in part)	13
Orchards	Deciduous orchards	6
Agricultural fields	Grain and hay fields	68
	Irrigated grain crops	20
	Irrigated hay fields	5
	Irrigated row and field crops	239
Non-native annual grassland	Grasslands and prairies	1,178
	Pasture	28
Unvegetated/ Developed	Unvegetated, vacant, or developed	724
Total project area		**3,022.3**

cover has been decreasing over time with increases in human populations throughout the Central Valley (Adams *et al.* 1992, Davis *et al.* 1998). Because upland woodland cover is required habitat by the evaluation species, and due to the recent historical trend of decreasing acreage, the Service designates upland woodland habitat within the project area as Resource Category 2, with its associated mitigation planning goal of "no net loss of in-kind habitat value."

No species was chosen as an evaluation species for the "Orchards" cover-type. The orchards in the project area are intensively managed for fruit and nut production. However, orchards can provide habitat value to wildlife species similar to naturally occurring walnut "Upland woodlands." Any orchards that would be permanently removed from crop production should be replaced by "Upland woodland" to ensure no habitat value is lost. Therefore, the Service designates the "Orchards" cover-type in the project area as Resource Category 3, with a mitigation planning goal of "no net loss of habitat value, while minimizing loss of in-kind habitat value."

The evaluation species selected for the "Emergent wetland" cover-type is the marsh wren. Emergent wetland habitat provides important cover, foraging, nesting, and roosting habitat for such water associated birds as well as some amphibians and aquatic mammals. Insects and spiders are taken from vegetation, the wetland floor, as well as on the wing (Gutzwiller and Anderson 1987). For protection from predators, the marsh wren will usually construct nests in reedy vegetation about 15 inches above water 2 to 3 feet deep (Gutzwiller and Anderson 1987). Because of the medium to high value of this habitat to the evaluation species, and its relative scarcity, the Service designates any emergent wetland habitat within the project area as Resource Category 2, with its associated mitigation planning goal of "no net loss of in-kind habitat value."

Table 8. Evaluation species, resource categories, and mitigation planning goals for the cover-types within the study area of the West Sacramento Flood Control Project, City of West Sacramento, Yolo County, California.

COVER-TYPES	EVALUATION SPECIES	RESOURCE CATEGORY	MITIGATION GOAL
Riparian scrub/woodland	Downy woodpecker Yellow warbler	2	No net loss of in-kind habitat value or acreage.
Upland woodland	Downy woodpecker Wild turkey	2	No net loss of in-kind habitat value or acreage.
Orchards	None	3	No net loss of habitat value, while minimizing loss of in-kind habitat value.
Emergent wetland	Marsh wren	2	No net loss of in-kind habitat value or acreage.
Seasonal wetland	Great blue heron	2	No net loss of in-kind habitat value or acreage.
Shallow water riverine Shaded riverine aquatic	Salmonids Herons and egrets	2 1	No net loss of in-kind habitat value or acreage. No loss of existing habitat value.
Agricultural fields	Black-shouldered kite California vole	4	Minimize loss of habitat value.
Non-native annual grassland	Black-shouldered kite California vole	3	No net loss of habitat value, while minimizing loss of in-kind habitat value.
Unvegetated/ Developed	None	4	Minimize loss of habitat value.

The evaluation species selected for the "Seasonal wetland" cover-type is the great blue heron. Great blue herons occur in a variety of freshwater and brackish habitats where they feed on fish, tadpoles, frogs and toads, and lizards, among other things (Short and Cooper 1985). Herons often feed in marshes and areas of open water, where there is no concealing cover (Short and Cooper 1985). The Seasonal wetland cover-type within the West Sacramento GRR project area is created in lowland areas that may not be natural, yet are of medium to high value for the selected evaluation species. Therefore, the Service designates the Seasonal wetland cover-type as Resource Category 3, with an associated mitigation planning goal of "no net loss of habitat value, while minimizing loss of in-kind habitat value."

Evaluation species chosen to represent the "Shallow water riverine" cover-type in the project area include salmonids, along with herons and egrets. Not only do wading birds (e.g., herons and egrets) use shallow water cover for feeding, but also a number of gamefish, including sunfish, catfish and striped bass. Shallow water of the riverine system is also part of the critical habitat designated for the federally-listed delta smelt and Sacramento River winter-run Chinook salmon. Such shallow

water is generally removed when typical bank protection is done, especially when the waterside of the levee is reshaped. The result is likely to be higher velocities and deeper water along the new shoreline. Compounding the problem is the large amount of riprap that has already been placed in the vicinity of the proposed action, thus effectively removing many miles of shallow, open water. Salmonids were selected because large declines in their numbers are among the most important resource issues in the region, and because of their very high commercial and sport fishing values. Herons and egrets were selected because of the Service's responsibilities for their management under the Migratory Bird Treaty Act, their relatively high value for non-consumptive human uses, such as bird watching, and their value as indicator species for the many birds which use cover and foraging habitat along riverine edges. Therefore, the Service designates the "Shallow water riverine" cover-type as Resource Category 2, with an associated mitigation planning goal of "no net loss of in kind habitat value or acreage."

Shaded Riverine Aquatic (SRA) cover is defined as the shallow water area occurring at the interface between a river and adjacent woody riparian habitat. The principal attributes of this valuable cover type include: (a) the adjacent bank being composed of natural, eroding substrates supporting riparian vegetation that either overhangs or protrudes into the water, and (b) the water containing variable amounts of woody debris, such as leaves, logs, branches and roots, as well as variable depths, velocities, and currents. These attributes provide high-value feeding areas, burrowing substrates, escape cover, and reproductive cover for numerous regionally important fish and wildlife species, including the State- and federally-listed species. In 1992, the Service designated SRA cover that is impacted by bank protection activities within the Sacramento Bank Protection Project action area as Resource Category 1 (Service 1992). Under Resource Category 1, habitat to be impacted is high value, unique, and irreplaceable on a national basis or in the eco-region, and the Service's mitigation planning goal is for no loss of existing habitat value.

The evaluation species selected for the "Agricultural fields" cover-type that would be impacted by the proposed project are the black-shouldered kite (white-tailed kite) and the California vole. The black-shouldered kite in California is a common species of open and cultivated bottomland (Faanes and Howard 1987). The black-shouldered kite is an obligate predator on diurnal small mammals; movements and nesting of the kite is largely governed by concentrations of mice and voles (Faanes and Howard 1987). The California vole is a widespread and common herbivore in California (Brylski 1990). Its abundance and widespread distribution, along with daylong activity, make the California vole an important prey species. Because this habitat is not a native and is managed for crop production unless fallowed, the Service designates the "Agricultural fields" habitat in the project area as Resource Category 4, with a mitigation planning goal to "minimize loss of habitat value."

Similarly, the evaluation species selected for the "Non-native annual grassland" cover-type that would be impacted by the proposed project also are the black-shouldered kite and the California vole. Because this cover-type within the City of West Sacramento is of medium to high value for the selected evaluation species, the Service designates the annual grassland cover-type as Resource Category 3, with an associated mitigation planning goal of "no net loss of habitat value, while minimizing loss of in-kind habitat value."

No evaluation species were selected for the "Unvegetated/ Developed" cover-type, This cover-type includes those areas which do not fall within one of the other habitat types, such as roads, access areas, buildings, bare ground, and riprap. Generally, this cover-type would not provide any

significant value for wildlife species. Therefore, the Service designates the "Unvegetated/ Developed" cover-type in the project area as Resource Category 4, with an associated mitigation planning goal of "minimize loss of in-kind habitat value."

BIOLOGICAL RESOURCES

The West Sacramento GRR involves construction zones for levee and roads; demolition areas for levees, roads, and structures; traffic and staging areas for project vehicles, equipment, and materials; and potential borrow areas for materials.

Vegetation

A combination of aerial photograph interpretation and field observation was used to identify land cover-types in the study area. Of the cover-types that occur in the study area, five are considered natural communities: riparian scrub/woodland, upland woodland, emergent wetlands, seasonal wetlands, and open water. The others are associated with human activities: orchards; agricultural fields; non-native annual grasslands; and unvegetated/developed. Each land cover-type is discussed below.

Riparian Scrub/Woodland

As corridors between wetland and upland land cover-types, riparian scrub/woodland cover can provide complexity in vegetation composition and structure, as well as species diversity. Most riparian scrub/woodland cover is associated with the Sacramento River north and Sacramento River south levees, but smaller riparian areas are found on all of the levees in the West Sacramento GRR project area. The total area encompassed by riparian scrub/woodland habitat in the study area is about 239 acres.

Riparian scrub/woodland cover in the project area is dominated by Fremont cottonwoods, Goodding's black willow, valley oak, and northern California black walnut. A common understory species is blue elderberry, which is the host plant for the valley elderberry longhorn beetle. Northern California black walnut is the dominant riparian tree species in some areas. Plant species associated with riparian scrub/woodland include valley oak, sandbar willow, red willow, poison-oak, and Himalayan blackberry.

Some trees in the riparian scrub/woodland are heritage or landmark trees, as defined in the Tree Preservation Ordinance of the City of West Sacramento. Valley oak riparian woodland (Great Valley valley oak riparian) is identified as a sensitive natural community (CDFG 2003). Riparian woodland (Great Valley cottonwood riparian) is identified as a sensitive natural community (CDFG 2003). The California Department of Fish and Wildlife (CDFW) has adopted a no-net-loss policy for riparian habitat values.

Upland Woodland

Small patches of woodland occur in the study area along the Sacramento River north and Sacramento River south levees, and at the junction of the Sacramento River south and South Cross levees. Woodland and forest encompass approximately 16 acres. These patches of woodland are distinguished from the riparian scrub/woodland habitat by a predominance of valley oaks. Generally, upland woodlands of the Sacramento Valley have a moderate shrub cover interspersed with herbaceous cover. Elderberry, coyote brush, and Himalayan blackberry are common understory shrubs.

As with the Riparian scrub/woodland cover, some of the trees meet the definition of heritage or landmark trees as defined in the City's Tree Preservation Ordinance. Valley oak woodland is identified as a sensitive natural community (CDFG 2003).

Emergent Wetland
There are about 86 acres of emergent wetland within the study area. The largest areas of emergent wetland occur in the vicinity of the turning basin along the Port north and Port south levees. Emergent wetlands also are in the study area near the South Cross, Yolo Bypass, and DWSC west levees. Representative species observed in emergent wetlands in the study area were tules, cattails, and rushes. Much of the emergent wetland in the project area represents jurisdictional waters of the United States that may be subject to regulation by the Corps. Emergent wetland cover is also recognized as a sensitive natural community by the CDFW (CDFG 2003).

Seasonal Wetland
Four small seasonal wetlands occur in the study area at the eastern end of the Port south levee, totaling about 0.3 acre. These wetlands appear to be inundated during wetter times of the year and ongoing and past disturbance contributed to the formation of three of the four seasonal wetlands that appear to have originated from tire tracks within the network of dirt trails in the basin south of South River Road. Representative plant species observed in the seasonal wetlands were hyssop loosestrife, Mediterranean barley, Italian ryegrass, and fiddle dock.

Shallow water riverine
There are about 413 acres of riverine aquatic water cover within the project area. The areas include the Sacramento River, DWSC, and turning basin of the Port of West Sacramento. These navigable waters are considered U.S. jurisdictional waters under Corps jurisdiction. Although much of the riverine aquatic habitat of the project area along the Sacramento River contains shallow water at banksides and SRA cover, areas of rock slope protection do exist. The DWSC and Port of West Sacramento areas do not contain substantial SRA cover. SRA provides high-value feeding area, burrowing substrates, escape cover, and reproductive cover for numerous regionally important fish and wildlife species. Non-shaded riverine aquatic cover lacks most of the benefits that natural vegetation provides.

Orchards
Deciduous orchards in the project area are confined to a small area near the Sacramento River south levee that encompasses about 6 acres. The orchards are managed for nut production, and therefore are likely subject to herbicide and pesticide applications for cultivation and harvesting, along with heavy pruning and cultivation.

Agricultural Fields
Cultivated agricultural fields include large parcels of wheat, ryegrass, and row crops totaling about 332 acres. Agricultural fields may be vegetated or non-vegetated, depending on management concerns. Irrigated row and field crops occur in the project area along the Yolo Bypass, Sacramento River south, and South Cross levees and encompass about 239 acres. Most of the irrigated row and field crops along the Yolo Bypass levee appear to be rice fields. Other grain and hay fields total about 93 acres. However, most agricultural fields in the project area have gone fallow, and appear not to be managed for current production. Fallow agricultural fields resemble nonnative annual grasslands in composition, and may contain small, common shrubs as well.

Nonnative-Annual Grassland

Nonnative annual grassland occurs in the project area mainly on undeveloped parcels, yet also on levee slopes and along roadsides. Non-native annual grassland cover approximately half of the study area and encompass a total of about 1,178 acres. Another 28 acres of pasture occur in small patches within the study area near the Sacramento River south and Port north levees and provide grazing areas for cattle and horses. The largest non-native annual grassland area occurs near the DWSC east, Port south, and DWSC west levees, but grasslands are scattered throughout the study area. The non-native annual grassland is dominated by naturalized annual grasses with intermixed perennial and annual forbs. Grasses commonly observed in the study area are foxtail barley, ripgut brome, Italian ryegrass, and soft chess. Other grasses observed were wild oats, Bermuda grass, and rattail fescue. Forbs commonly observed in annual grasslands in the study area are yellow star-thistle, prickly lettuce, bristly ox-tongue, and sweet fennel. Other forbs observed are perennial peppergrass, Italian thistle, horseweed, black mustard, and fireweed. The nonnative annual grasslands in the project area contain a relatively large proportion of ruderal species, likely because of substantial disturbance from human activities.

Unvegetated/Developed

The Unvegetated/Developed cover-type applies to landscaped residential parcels, roads, and other large paved areas and total about 724 acres. Most of the Unvegetated/Developed areas in the study area occur north of the DWSC along the Sacramento River north, Yolo Bypass, Sacramento Bypass, and Port north levees. Although landscaping can provide value to some terrestrial species, generally the cover is fragmented and frequented by human activity. These qualities lead to low habitat value. Vacant areas within the study area commonly contain ruderal species that have the ability to colonize disturbed areas: bristly ox-tongue, yellow star-thistle, common mallow, milk-thistle, prickly lettuce, chicory, and perennial peppergrass. Vegetation in developed portions of the study area consists of ornamental species used for landscaping: English ivy, crape myrtle, liquid amber, edible fig, and privet.

Wildlife

In addition to providing important nesting and foraging habitat, riparian habitats function as wildlife movement corridors. Overstory trees may be used for nesting and roosting by numerous raptors, including Swainson's hawk, black-shouldered kite, red-tailed hawk, red-shouldered hawk, great horned owl, Cooper's hawk, and American kestrel. Overstory riparian trees also provide suitable roosting sites for herons and egrets, as well as the belted kingfisher. Overstory trees provide foraging opportunities for other birds such as the Bullock's oriole, yellow-rumped warbler, tree swallow, and western scrub jay. Understory riparian habitat is also suitable for numerous mammals, including various species of rodents, raccoon, Virginia opossum, and striped skunk. Areas containing large, dense shrubby vegetation dominated by willow or blackberry may support tricolored blackbird. Riparian forests also provide cover and foraging habitat for reptiles and amphibians, such as terrestrial garter snake, gopher snake, Pacific tree frog, and western toad. Suitable areas in the understory also may be used as nesting habitat for western pond turtles.

Patches of upland woodland are dominated by valley oak and provide similar wildlife habitat uses as riparian scrub/woodland. Along with those species that use riparian habitats, additional birds that use upland woodland cover include the yellow-billed magpie, Nuttall's woodpecker, acorn woodpecker, and northern flicker. Reptiles including gopher snake, California king snake, and the northern pacific rattlesnake also frequent these habitats.

Although emergent wetland does not occur in large continuous patches within the project area, this habitat type is designated as a sensitive natural community by CDFW (CDFG 2003) and provides important wildlife habitat value. This cover-type provides nesting and foraging habitat for several songbirds, including red-winged blackbird, tricolored blackbird, and marsh wren; foraging and nesting habitat for northern harrier and Virginia rail; foraging and cover habitat for numerous reptiles and amphibians; and potential nesting habitat for western pond turtle. Likewise, seasonal wetlands provide breeding habitat for amphibians, as well as foraging habitat for several mammals, birds, reptiles, and amphibians.

Within the project area, open water provides breeding, foraging, and migration habitat for many wildlife species. Mammal species commonly known to use open water habitats include river otter, which uses these areas for foraging and escape cover, and muskrat, which may use open water as migration corridors between suitable foraging areas. Open water areas also provide essential foraging habitat for wading birds including great blue heron, great egret, and snowy egret; numerous waterfowl species including mallard, ruddy duck, and bufflehead; other water birds including eared grebe, double-crested cormorants, and American white pelicans; and land birds including black phoebe and belted kingfisher. These areas also provide breeding habitat, escape cover, and foraging habitat for reptiles and amphibians including western pond turtle, common garter snake, giant garter snake, bullfrog, Pacific tree frog, and western toad. The vegetated areas within open water provide nesting habitat for numerous songbirds, including red-winged blackbird and marsh wren, and wading birds such as Virginia rail.

Orchard crops typically provide less value to wildlife than natural woodland cover-types, yet also may be used for nesting or foraging by species that use woodland habitats. Likewise, agricultural crop lands can provide some habitat value similar to grassland. However, because agricultural fields and orchards are managed for crop production, insects and other vegetation in these cover-types are heavily controlled. Such management objectives can limit the habitat value of these cover-types to birds, small mammals, reptiles, and amphibians. However, agricultural cover-types do provide some habitat value to numerous resident and wintering raptors, songbirds, shorebirds, and wading birds. Agricultural lands also provide foraging habitat for rodents including deer mouse and the California vole; other mammals including coyote, raccoon, Virginia opossum; and reptiles including gopher snake and terrestrial garter snake.

Non-native grassland generally occurs in disturbed areas, such as levee faces and edges of agricultural fields and roads; the species in this land cover type are generally weedy to invasive. The largest area of non-native annual grassland occurs on levees adjacent to the DWSC and Port South Canal, but grasslands are generally scattered throughout the study area. Grasslands provide nesting and foraging habitat for several species of songbirds, including the savanna sparrow, white-crowned sparrow, and western meadowlark. Grasslands also provide foraging habitat for several species of raptors including red-tailed hawk, white-tailed kite, northern harrier, great-horned owl, and Swainson's hawk. California ground squirrels commonly occur in annual grassland habitat. Their burrows provide important nesting habitat for western burrowing owls. Reptiles found in these habitats include California kingsnake, gopher snake, and northern pacific rattlesnake. Additionally, annual grassland areas surrounding levees and those adjacent to aquatic habitat may also provide potential upland habitat for giant garter snake.

Unvegetated/developed lands include areas within levee roads, railways, roads, buildings, and landscaped areas, as well as other barren areas that have been disturbed. Due to frequent human disturbance, these areas typically provide minimal habitat value to wildlife.

Fish

Aquatic habitat in the project area consists mainly of the Sacramento River, the DWSC, and Port of West Sacramento areas. Areas of shallow open water also can be found in drainage canals, Bees Lakes, and other isolated ponds. However, due to the shallowness and isolation of these water bodies, their value as fish habitat is limited.

Along the river, riparian vegetation provides SRA cover and aids in temperature control, streambank stability, and habitat complexity. Floodplain and SRA cover along the Sacramento River is used by all life stages of anadromous fish for shelter and feeding. Additionally, vegetated floodplain and SRA cover provides habitat for Sacramento splittail, delta smelt, black bass, and sunfish.

Root structures of riparian vegetation can provide bank stability and shelter for young fish. Woody debris can provide shelter from predation and refugia from stream flow. Riparian vegetation also influences the food chain of a stream, providing organic detritus and terrestrial insects. Terrestrial organisms falling from overhanging branches contribute to the food base of the aquatic community. Vegetation in emergent wetlands can provide similar benefits to fish habitat. Salmonids in particular are primarily insectivores and feed mainly on drifting food organisms. Along with providing water storage, floodplains can add extensively to the habitat components of SRA cover.

The Sacramento River channel provides a migratory pathway to many anadromous fish, and also provides seasonal rearing habitat to many other native fish species (Table 9). Non-native anadromous species such as the American shad and striped bass provide recreational sport fishing opportunities. Non-native resident species include several catfish, bass, bluegill, crappie, and sunfish species. Some non-native species may provide recreational fishing opportunities, such as the largemouth bass, smallmouth bass, and green sunfish, yet these species also prey upon native

Table 9. Native fish species potentially occurring in the Sacramento River, adjacent to the West Sacramento Flood Control Project, Yolo County, California.

Resident	Anadromous
California roach	Chinook salmon (winter, spring, fall, and late-fall runs)
Delta smelt	Chum salmon
Hardhead	Green sturgeon
Hitch	Pacific lamprey
Longfin smelt	River lamprey
Prickly sculpin	Steelhead
Sacramento blackfish	White sturgeon
Sacramento pikeminnow	
Sacramento splittail	
Sacramento sucker	
Speckled dace	
Threespine stickleback	
Tule perch	

juvenile species that use floodplain habitats. The native California roach may be extirpated from the Sacramento River adjacent to the project area due to predation from non-native species (Moyle 2002). Similarly, the native Sacramento perch has been extirpated from much of its former range as a result of predation from non-native carp and catfish (Moyle 2002).

Threatened and Endangered Species

Appendix B contains a list of federally listed species which may be found in the project area. Consultation under section 7 of the Endangered Species Act has been completed with the Service (Appendix C), and consultation with the National Marine Fisheries Service (NMFS) is ongoing. Generally, the Service has jurisdiction for land and freshwater species, while the NMFS has jurisdiction for marine and anadromous species. The CDFW should be consulted under the California Endangered Species Act to determine the effects of this project on State listed species.

FUTURE CONDITIONS WITHOUT THE PROJECT

Vegetation - The No Action Alternative represents the continuation of the existing levee conditions, including deficiencies, along the waterways surrounding the North and South Basins of the WSFCP. Because no levee improvements would occur, no construction related effects on vegetation or land cover-types would occur. Erosion could lead to levee failures and the loss of existing vegetation. Future compliance with the Corps levee vegetation policy could lead to permanent loss of woody vegetation which would result in a significant effect on riparian habitat.

Wildlife - Since only minimal changes are expected in vegetation, wildlife populations in the study area are expected to persist as they are currently, with normal year-to-year fluctuations of individual species.

Fish - Under the No Action Alternative, the aquatic resources are expected to remain the same for fish species. As with current Sacramento River conditions, aquatic species populations would fluctuate in relation to water temperature, rainfall, contaminants, and other natural population cycles.

Current levee operation and maintenance activities would continue as is, and there would be no change in the geomorphic or flood control regimes, resident and migratory fishes would continue to use the area as they do today. Alterations to levee management policies concerning current vegetation composition and structure could lead to a permanent loss of woody materials, resulting in major impacts to existing riparian habitat. The loss of riparian habitat would negatively impact fish populations of the Sacramento River.

Because no levee improvements would be made under the No Action Alternative, existing flood risks would continue. In general, future conditions for fish and wildlife species are expected to remain within the current dynamic ecological conditions. As with current conditions, populations would fluctuate, depending on weather, rainfall, contaminants, diseases, and natural population cycles.

FUTURE CONDITIONS WITH THE PROJECT

Vegetation - Regardless of the project action alternative, wildlife habitats will be impacted along 51 linear miles of levees around the City of West Sacramento. Additionally, potential road construction, potential construction borrow areas, changes in traffic alignment, and other project activities also would affect existing habitat cover. For example, habitat may be lost for the western burrowing owl through road construction or the extraction of borrow materials. Although each Alternative is unique, similarities exist among the Alternatives regarding the impacts to habitat.

Wildlife - With the project, the alternatives address levee deficiencies through various combinations of slurry cutoff walls, seepage berms, and rock slope protection (riprap). These construction activities could result in potential adverse effects on resident wildlife resources. Not only can animals be physically displaced, but effects include disturbance from construction activity and noise. Amphibian and reptile species typically are not as mobile as other types of wildlife. Consequently they have a greater chance of being killed during construction activities, including the collection of borrow material. Giant garter snakes may use habitat along the DWSC adjacent to the Yolo Bypass as well as the South Cross levee, which borders potential borrow sites to the north and south.

Wildlife such as birds and mammals, typically respond to this type of activity by leaving construction areas. It is likely they would move into adjacent habitat outside of the zone of construction noise and disturbance. However, they may be forced to move to less than optimal habitat conditions as other animals may have established territories in the surrounding habitat. Swainson's hawks, a State listed species, relies on mature riparian cover for nesting and foraging. Similarly, several bat species may use riparian cover for roosting. Pre-construction nesting bird surveys would help avoid disturbing or destroying any nests within the vegetation removal area and assist in complying with the Migratory Bird Treaty Act.

Construction effects to invertebrate species must be considered as well. The valley elderberry longhorn beetle uses elderberry as its sole host plant. Therefore, the effects of construction activities on elderberry bushes, regardless of the alternative chosen, must be analyzed fully.

Fish – Regardless of the project action alternative chosen, rock slope protection would be used along the Sacramento north and south levees, as well as the DWSC West levee. Using rock slope protection would permanently remove SRA cover along the Sacramento River. SRA cover provides shelter, resting, rearing, and feeding areas to multiple fish species (NMFS 2008). The loss of SRA cover can negatively impact anadromous fish by removing protective cover from juveniles. Smaller resident fish would also be negatively impacted by the loss of protective cover. Other benefits provided by streamside vegetation, such as temperature and erosion control, would be permanently lost.

A setback levee alignment with a larger floodplain and riparian areas can increase benefits to resident and anadromous fish species. Higher growth rates of Chinook salmon have been observed in fish growing in floodplain areas than in conspecifics growing in main channel flows (Limm and Marchetti 2003). Ecologically, much of the biomass produced in riparian and floodplain areas can eventually flow into open water in the form of detritus and stranded terrestrial insects. However, floodplains carry increased risks of fish stranding, poor oxygen levels, and increased predation if watered areas become cut off from main channel flows (Jeffres *et al.* 2008).

Alternative 1 – Fix Levees- The Fix Levees Alternative involves in-place levee remediation measures to address seepage and stability deficiencies. Cutoff walls would be installed in all levee reaches except the Port north and Sacramento Bypass Training areas. To address overtopping levees would be raised in sections along the Sacramento River, the DWSC, and the Port south areas. In areas where woody vegetation is not removed, wildlife species may be temporarily displaced during project construction due to disturbance. Each levee reach is expected to involve 2 years of construction.

Upon remediation levees along the Sacramento River, Sacramento Bypass, and the DWSC would be lined with rock slope protection. The existing slopes contain a combination of riparian woodland, riparian scrubland, and non-native annual grassland. Possible construction effects include increases in turbidity and suspended sediment due to riprap placement, possible contaminant discharge from the construction equipment, and adverse effects caused by construction noise and vibration. On the landside, seepage berms would be constructed in segments along the Sacramento south, South Cross, and DWSC levees. The creation of seepage berms requires the removal of additional vegetation in multiple areas along the existing landside levee toe.

Wooded riparian and grassland habitats are used by numerous mammals, reptiles, amphibians, and birds found throughout the Sacramento Valley. Often in suburban and urban landscapes, these areas provide a network of natural cover in an otherwise fragmented landscape. Woody vegetation can also provide SRA cover for fish, which is important for a variety of reasons, including temperature regulation. Downed woody debris can also provide habitat for invertebrate species and cover for both terrestrial and aquatic wildlife.

Alternative 2 – Fix Levees and Widen Sacramento Weir and Bypass- Alternative 2 levee alignments are the same as with Alternative 1, except for widening the Sacramento Bypass and Weir. The widening of the bypass involves the degradation of the existing north levee and subsequent creation of a new north levee along the Sacramento Bypass. Although plans for the widening have not been finalized, there is some riparian woody vegetation along the north levee that likely would be removed. Agricultural lands on the landside of the existing levee would be replaced by the grasslands within the newly created bypass and north levee alignment.

The type of weir that would be created with a widened Sacramento Bypass has not been finalized. Depending on the design and natural water flow, more emergent wetlands could be created within the Sacramento Bypass. Except for high-water events, most of the expanded Sacramento Bypass is expected to contain annual grasslands similar to what currently exists within the bypass.

Alternative 3 – Fix Levees and Deep Water Ship Channel Closure Structure- Alternative 3 levee alignments are the same as with Alternative 1, except for the inclusion of a DWSC Closure Structure. Depending on the placement of the Closure Structure, it is likely that the structure would affect annual grassland and unvegetated cover. However, implementing a closure structure would in turn alleviate the need for improvements along the DWSC east and west levees north of the Closure Structure. Also, depending on construction schedules, building the Closure Structure may temporarily affect fish movement in the DWSC.

Alternative 4 – Fix in Place, Sacramento Bypass Widening, and DWSC Closure Structure- Alternative 4 contains the fix-in place levee alignments, along with the Sacramento Bypass widening

of Alternative 2 and the DWSC Closure Structure of Alternative 3. Effects to vegetation cover, wildlife, and fish are a combination of the effects under Alternatives 1, 2, and 3.

Alternative 5 – Fix in Place, Setback Levee, Sacramento Bypass Widening, and DWSC Closure Structure- As with Alternative 4, effects under Alternative 5 to vegetation, wildlife, and fish are generally a combination of the effects under Alternatives 1, 2, and 3. However, Alternative 5 also involves a setback levee alignment along the Sacramento River south levee.

On the waterside, a setback levee would create floodplain area at least 400 feet wide from the levee toe to the Sacramento River. The existing levee would be breached in five locations. Riprap would be used for erosion protection in other areas of the obsolete existing levee to maintain proper floodplain function. The floodplain would vary in height to allow a more natural riparian – wetland interface. Supplemental plantings would increase the amount of existing wooded riparian and wetland habitats. The creation of the floodplain area results in a net increase of riparian and other wooded cover. Although riprap would be used along existing levee alignments to the north and south of the setback area, the increased riparian acreage increases the functionality as wildlife habitat along the waterside of the project area.

The increased floodplain area allows the Sacramento River to function more naturally between the cities of Sacramento and West Sacramento. The inundation of the new floodplain area would vary accordingly with water levels. Floodplain habitat can provide shade and structure for fish to use for escaping higher velocity flows and predators. Some bird species such as herons and egrets also can use this habitat for foraging. Additionally, the Bees Lakes would retain hydraulic isolation from the Sacramento River.

On the landside, the setback levee includes seepage berms that would not contain woody vegetation. The loss of wooded habitats on the landside would be offset by plantings on the waterside. Agricultural fields, undeveloped lands, and other habitats would be impacted to create new roadways.

DISCUSSION

The Service's primary concern with the effects to fish and wildlife is the loss of riparian and wetland habitats. The inclusion of the setback levee alignment in Alternative 5 offers the ability to compensate onsite for losses of wooded and wetland habitats due to construction. Onsite compensation allows for the continuance of the landscape context of the land cover, thus providing connectivity and decreasing chances of habitat fragmentation in the West Sacramento GRR area.

To mitigate the loss of this habitat for wildlife species the Service believes that a ratio of at least 2:1 should be used to compensate for the loss of riparian scrub/woodland, upland woodland, emergent wetland, and emergent wetlands habitat values. The ratio accounts for temporal losses while vegetation matures over time. Table 10 summarizes the compensation needs for the project's preferred plan locally. Nonnative annual grasslands and former agricultural lands that will not return to production should be reseeded with a native seed mix. Widening the Sacramento Bypass provides an opportunity to increase riparian and wetland cover within the project area and may be suitable for use as a compensation area.

Table 10. Compensation need for the habitats affected by the West Sacramento GRR Project, Preferred Alternative, City of West Sacramento, Yolo County, California.

Habitat Cover-Type	Area Affected (acres)	Compensation Need (acres)
Riparian scrub/woodland	239	478
Upland woodland	16	32
Emergent wetlands	86	192
Ponds	0.0	Not Applicable
Shallow water habitat	13	26
Orchard and Agricultural fields	6	Re-seed
Non-native annual grassland	1,206	Re-seed
Unvegetated/Developed	Unknown	Re-seed*

* Any areas left unvegetated should be re-seeded with a native seed mix.

Alternative 5, which includes the setback levee option, benefits fish and wildlife species by creating more floodplain habitat. The setback levee decreases the chances of levee erosion in the immediate area by slowing stream flow through widening the channel and placing vegetation in the new floodplain. Throughout the Sacramento River system, the Service's goal is to work toward the creation of a sustainable, reliable, and resilient flood and riparian system. Setback levee designs are a step in this direction.

Vegetation on river banks, as well as in floodplain habitats, is important in maintaining SRA cover, erosion control, roosting spots, cover from predation and for predators, and feeding opportunities for wildlife species. Means should be provided to allow woody vegetation to persist among rock slope protection so that losses of SRA cover and riparian cover can be minimized.

When specific compensation plans are being designed, they should include development of an operations maintenance manual for the site(s). New floodplain areas resulting from the setback levee designs should be contoured so they do not lose connectivity with the Sacramento River main channel and strand fish or develop pools with potential water quality issues. For compensation areas to be effective, they need to be managed in perpetuity, with established goals and a monitoring plan. Compensation goals should be clearly outlined and adaptive management measures should be established to ensure that compensation is achieved.

The recommendations below are based on preliminary construction designs for the West Sacramento GRR. Once specific project designs are developed, the Service's recommendations may be refined.

RECOMMENDATIONS

If the project is constructed, the Service recommends that the Corps implement the following:

1) Avoid the loss of SRA cover along the Sacramento River. Unavoidable impacts can be mitigated by planting native woody materials within rock slope protection areas. Work with the Service, NMFS, and CDFW to develop planting and monitoring plans and DWR and WSAFCA to develop a variance to allow vegetation within the Corps'

vegetation free zone to remain in place, especially in areas designed for rock slope protection.

2) Avoid impacts to nesting migrating birds by conducting pre-construction surveys for breeding migratory birds. Active nests should not be disturbed until young have fledged.

3) Minimize impacts to wildlife species by reseeding all lands disturbed by construction activities, including the staging areas, with native grasses and forbs. Similarly, agricultural lands remaining out of production should be reseeded with native forbs and grasses. Reseeding should be conducted just prior to the rainy season to enhance germination and plant establishment.

4) Compensate at 2:1 for losses due to project work by creating and maintain 478 acres of riparian woodland, 32 acres of upland woodland, 192 acres of emergent wetland, and 26 acres of shallow water riverine habitat. If onsite compensation is not possible, the Corps and WSAFCA should work with the Service and other resource agencies on the development of a suitable offsite compensation area.

5) Comply with local tree ordinance requirements for any landmark or heritage trees that are impacted by the project.

6) For all compensation areas, develop an operations and maintenance plan that is coordinated with the Service and other resource agencies.

7) Consult with the CDFW regarding effects of this project on State listed species under the California Endangered Species Act.

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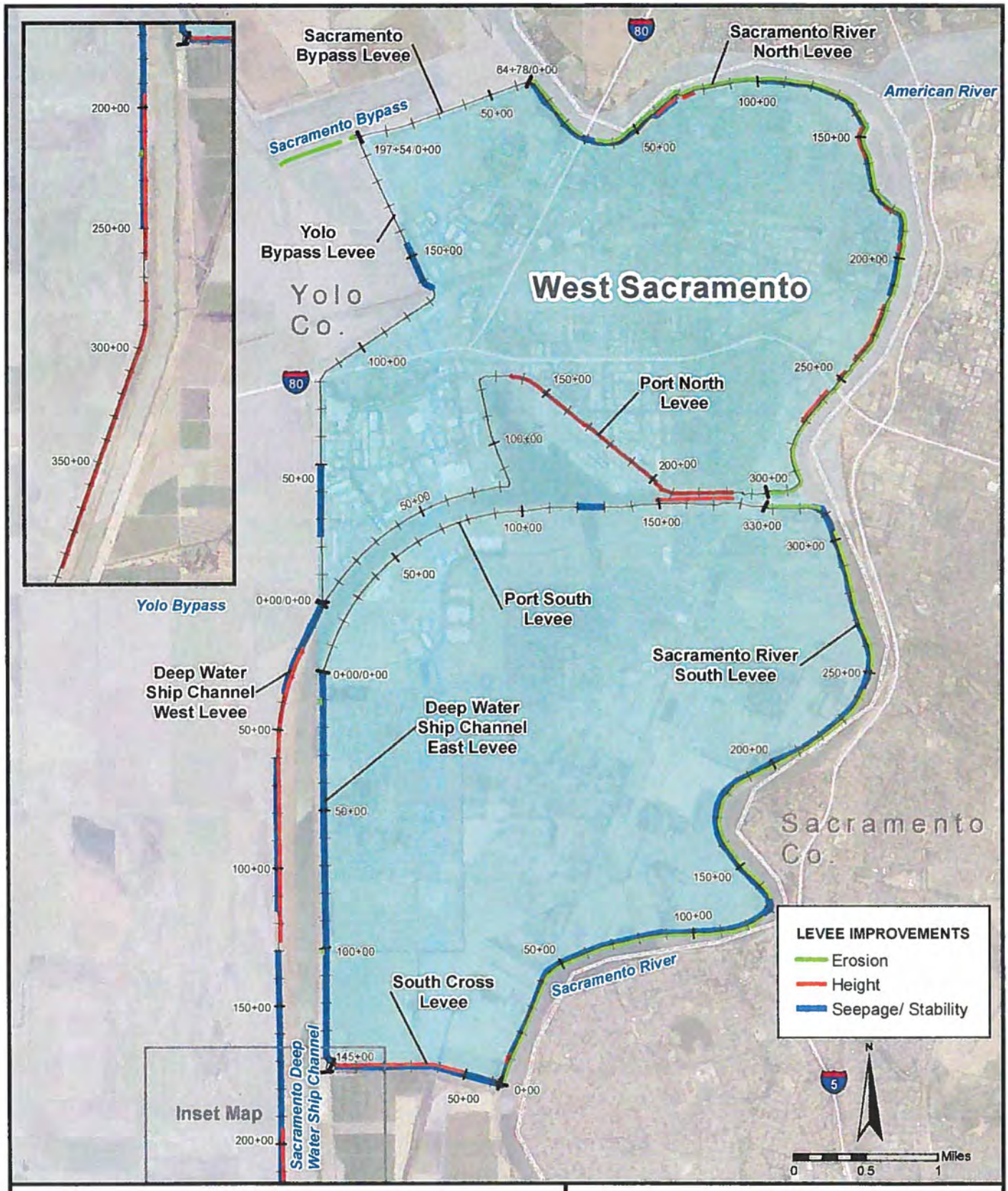
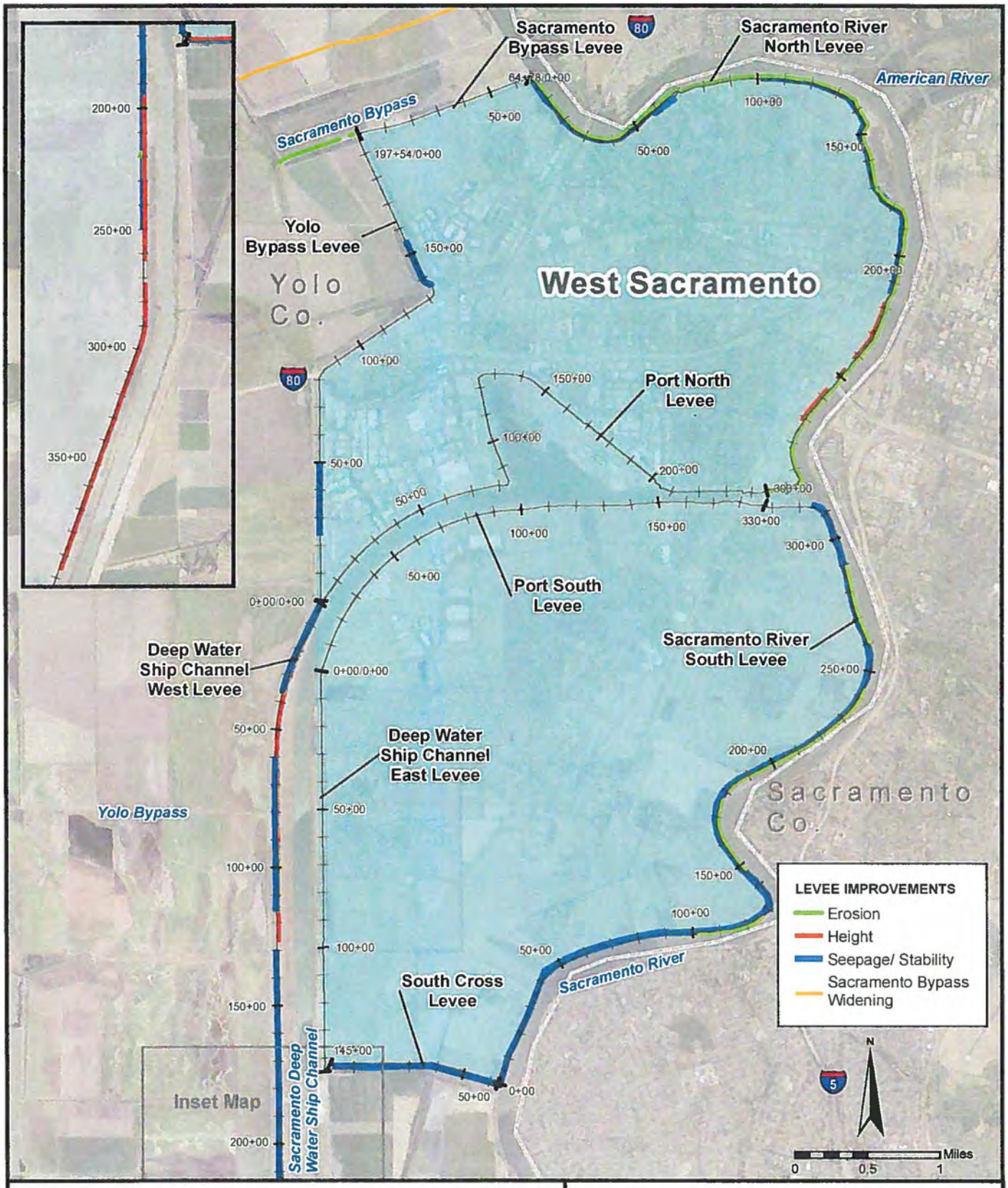
Appendix A

West Sacramento General Reevaluation Report Project
Post-Construction Design Alternatives


Sacramento Bypass Levee
Sacramento River North Levee
American River
Sacramento Bypass
Yolo Bypass Levee
Yolo Co.
West Sacramento
Port North Levee
Port South Levee
Yolo Bypass
Deep Water Ship Channel West Levee
Deep Water Ship Channel East Levee
Sacramento River South Levee
Sacramento Co.
South Cross Levee
Sacramento River
Sacramento Deep Water Ship Channel
Inset Map
LEVEE IMPROVEMENTS
Erosion
Height
Seepage/ Stability
N
Miles
0
0.5
1
Legend
Levee Centerline
Floodways
West Sacramento Project Area
County Lines
Map Extent
Carson City
Sacramento
San Francisco
San Jose
WEST SACRAMENTO GRR
WEST SACRAMENTO, CALIFORNIA
LEVEE IMPROVEMENTS
ALTERNATIVE 1
U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



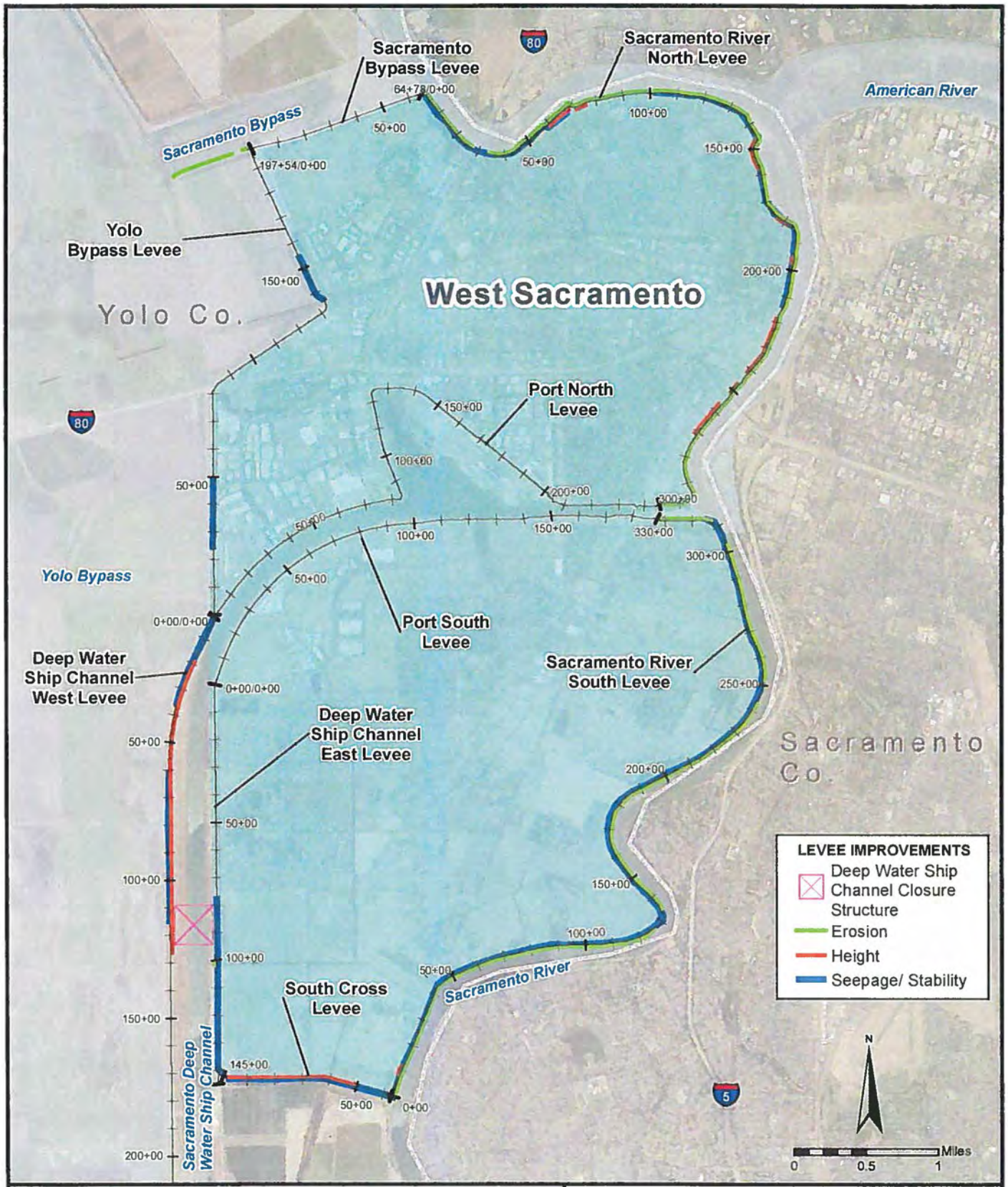
Legend

- Levee Centerline
- West Sacramento Project Area
- County Lines

WEST SACRAMENTO GRR
WEST SACRAMENTO, CALIFORNIA

LEVEE IMPROVEMENTS ALTERNATIVE 2

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



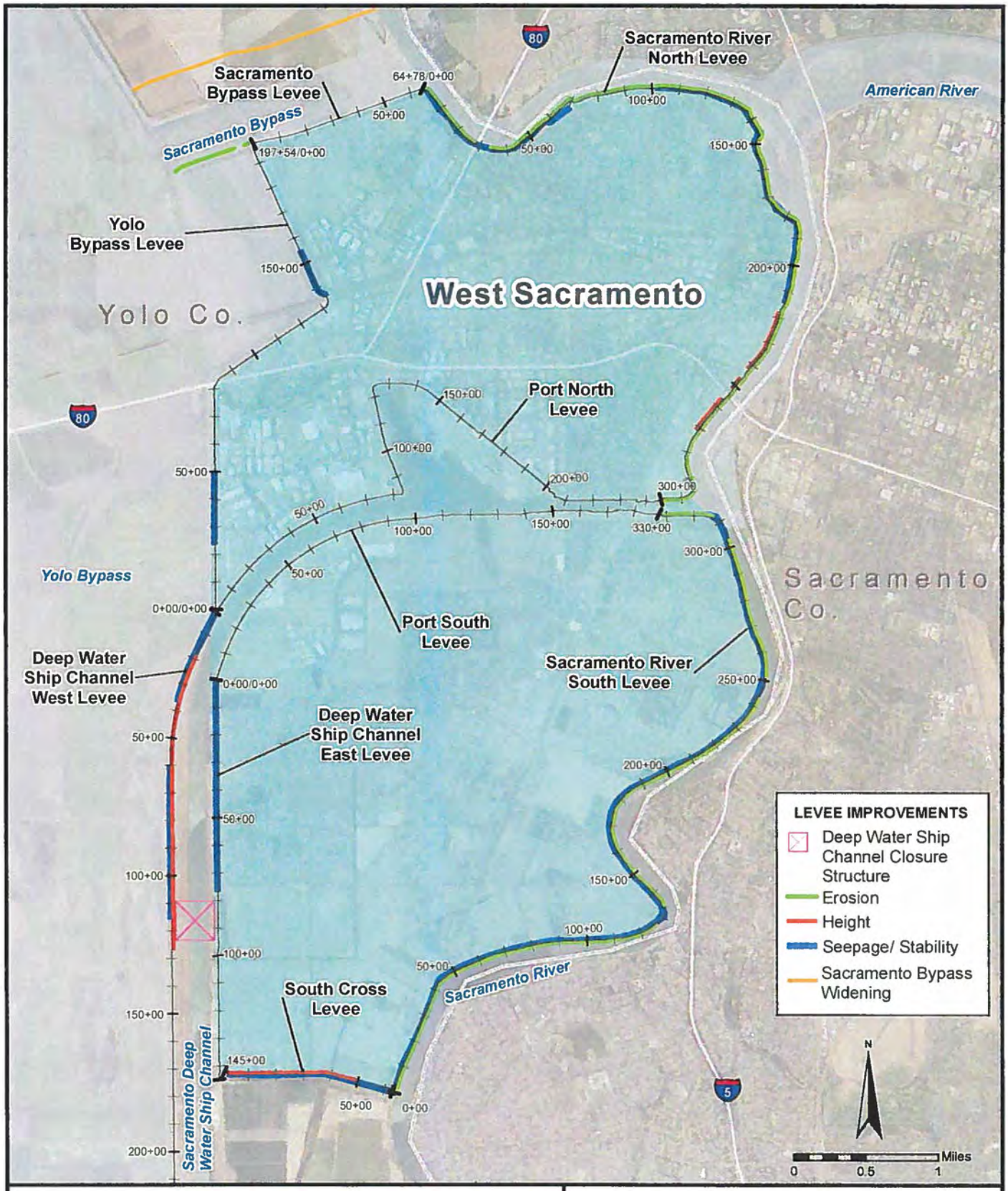
Legend

- Levee Centerline
- Floodways
- West Sacramento Project Area
- County Lines

WEST SACRAMENTO GRR
WEST SACRAMENTO, CALIFORNIA

LEVEE IMPROVEMENTS ALTERNATIVE 3

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT



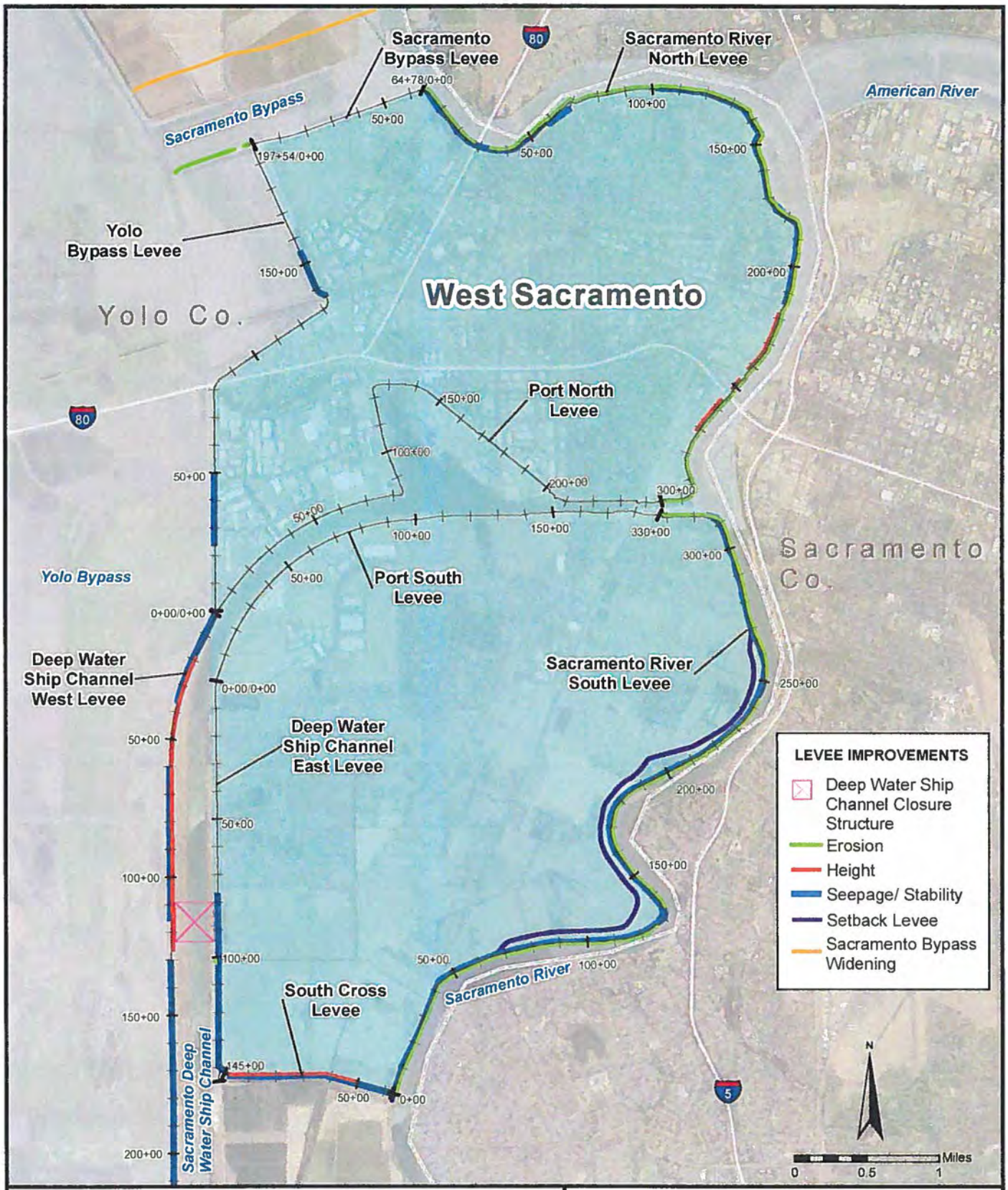
Legend

- Levee Centerline
- West Sacramento Project Area
- Floodways
- County Lines

WEST SACRAMENTO GRR
WEST SACRAMENTO, CALIFORNIA

LEVEE IMPROVEMENTS ALTERNATIVE 4

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT


Sacramento Bypass Levee
Sacramento River North Levee
American River
Sacramento Bypass
64+78/0+00
50+00
100+00
197+54/0+00
50+00
150+00
Yolo Bypass Levee
150+00
200+00
West Sacramento
Yolo Co.
Port North Levee
150+00
100+00
200+00
300+00
50+00
50+00
100+00
150+00
330+00
300+00
Sacramento Co.
Yolo Bypass
50+00
Port South Levee
0+00/0+00
Deep Water Ship Channel West Levee
Sacramento River South Levee
0+00/0+00
250+00
50+00
Deep Water Ship Channel East Levee
200+00
50+00
100+00
150+00
100+00
50+00
Sacramento River
100+00
South Cross Levee
150+00
145+00
50+00
0+00
Sacramento Deep Water Ship Channel
200+00
LEVEE IMPROVEMENTS
Deep Water Ship Channel Closure Structure
Erosion
Height
Seepage/ Stability
Setback Levee
Sacramento Bypass Widening
N
Miles
0
0.5
1
Legend
Levee Centerline
Floodways
West Sacramento Project Area
County Lines
Map Extent
Carson City
Sacramento
San Francisco
San Jose
WEST SACRAMENTO GRR
WEST SACRAMENTO, CALIFORNIA
LEVEE IMPROVEMENTS
ALTERNATIVE 5
U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT

Appendix B

Federal Endangered and Threatened Species that May Occur in or May be Affected by the Project

U.S. Fish & Wildlife Service
Sacramento Fish & Wildlife Office
Federal Endangered and Threatened Species that Occur in or may be Affected by Projects in the
Sacramento West
U.S.G.S. 7 1/2 Minute Quad
Document Number: 130703083953

Listed Species
Invertebrates

- *Branchinecta lynchi*
  - vernal pool fairy shrimp (T)
- *Desmocerus californicus dimorphus*
  - valley elderberry longhorn beetle (T)
- *Lepidurus packardi*
  - vernal pool tadpole shrimp (E)

Fish

- *Acipenser medirostris*
  - green sturgeon (T) (NMFS)
- *Hypomesus transpacificus*
  - Critical habitat, delta smelt
  - delta smelt (T)
- *Oncorhynchus mykiss*
  - Central Valley steelhead (T) (NMFS)
  - Critical habitat, Central Valley steelhead (NMFS)
- *Oncorhynchus tshawytscha*
  - Central Valley spring-run chinook salmon (T) (NMFS)
  - Critical Habitat, Central Valley spring-run chinook (NMFS)
  - Critical habitat, winter-run chinook salmon (NMFS)
  - winter-run chinook salmon, Sacramento River (E) (NMFS)

Amphibians

- *Ambystoma californiense*
  - California tiger salamander, central population (T)
- *Rana draytonii*
  - California red-legged frog (T)

Reptiles

- *Thamnophis gigas*
  - giant garter snake (T)

Birds

- *Coccyzus americanus occidentalis*
  - Western yellow-billed cuckoo (T)
- *Vireo bellii pusillus*
  - Least Bell's vireo (E)

Key:

- (E) Endangered - Listed as being in danger of extinction.
- (T) Threatened - Listed as likely to become endangered within the foreseeable future.
- (NMFS) Species under the Jurisdiction of the National Oceanic & Atmospheric Administration Fisheries Service. Consult with them directly about these species.
- Critical Habitat - Area essential to the conservation of a species.

Important Information About Your Species List

How We Make Species Lists

We store information about endangered and threatened species lists by U.S. Geological Survey 7½ minute quads. The United States is divided into these quads, which are about the size of San Francisco.

The animals on your species list are ones that occur within, or may be affected by projects within, the quads covered by the list.

- Fish and other aquatic species appear on your list if they are in the same watershed as your quad or if water use in your quad might affect them.
- Amphibians will be on the list for a quad or county if pesticides applied in that area may be carried to their habitat by air currents.
- Birds are shown regardless of whether they are resident or migratory. Relevant birds on the county list should be considered regardless of whether they appear on a quad list.
-

Plants

Any plants on your list are ones that have actually been observed in the area covered by the list. Plants may exist in an area without ever having been detected there. You can find out what's in the surrounding quads through the California Native Plant Society's online Inventory of Rare and Endangered Plants.

Surveying

Some of the species on your list may not be affected by your project. A trained biologist and/or botanist, familiar with the habitat requirements of the species on your list, should determine whether they or habitats suitable for them may be affected by your project. We recommend that your surveys include any proposed and candidate species on your list.

See our Protocol and Recovery Permits pages. For plant surveys, we recommend using our Guidelines for Conducting and Reporting Botanical Inventories. The results of your surveys should be published in any environmental documents prepared for your project.

Your Responsibilities Under the Endangered Species Act

All animals identified as listed above are fully protected under the Endangered Species Act of 1973, as amended. Section 9 of the Act and its implementing regulations prohibit the take of a federally listed wildlife species. Take is defined by the Act as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" any such animal. Take may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or shelter (50 CFR §17.3).

Take incidental to an otherwise lawful activity may be authorized by one of two procedures:

- If a Federal agency is involved with the permitting, funding, or carrying out of a project that may result in take, then that agency must engage in a formal consultation with the Service.
- During formal consultation, the Federal agency, the applicant and the Service work together to avoid or minimize the impact on listed species and their habitat. Such consultation would result in a biological opinion by the Service addressing the anticipated effect of the project on listed and proposed species. The opinion may authorize a limited level of incidental take.
- If no Federal agency is involved with the project, and federally listed species may be taken as part of the project, then you, the applicant, should apply for an incidental take permit. The Service may issue such a permit if you submit a satisfactory conservation plan for the species that would be affected by your project.
- Should your survey determine that federally listed or proposed species occur in the area and are likely to be affected by the project, we recommend that you work with this office and the California Department of Fish and Game to develop a plan that minimizes the project's direct and indirect impacts to listed species and compensates for project-related loss of habitat. You should include the plan in any environmental documents you file.

Critical Habitat

When a species is listed as endangered or threatened, areas of habitat considered essential to its conservation may be designated as critical habitat. These areas may require special management considerations or protection. They provide needed space for growth and normal behavior; food, water, air, light, other nutritional or physiological requirements; cover or shelter; and sites for breeding, reproduction, rearing of offspring, germination or seed dispersal.

Although critical habitat may be designated on private or State lands, activities on these lands are not restricted unless there is Federal involvement in the activities or direct harm to listed wildlife.
If any species has proposed or designated critical habitat within a quad, there will be a separate line for this on the species list. Boundary descriptions of the critical habitat may be found in the Federal Register. The information is also reprinted in the Code of Federal Regulations (50 CFR §17.95). See our Map Room page.

Candidate Species

We recommend that you address impacts to candidate species. We put plants and animals on our candidate list when we have enough scientific information to eventually propose them for listing as threatened or endangered. By considering these species early in your planning process you may be able to avoid the problems that could develop if one of these candidates was listed before the end of your project.

Species of Concern

The Sacramento Fish & Wildlife Office no longer maintains a list of species of concern. However, various other agencies and organizations maintain lists of at-risk species. These lists provide essential information for land management planning and conservation efforts.

Wetlands

If your project will impact wetlands, riparian habitat, or other jurisdictional waters as defined by section 404 of the Clean Water Act and/or section 10 of the Rivers and Harbors Act, you will need to obtain a permit from the U.S. Army Corps of Engineers. Impacts to wetland habitats require site specific

mitigation and monitoring. For questions regarding wetlands, please contact Mark Littlefield of this office at (916) 414-6520.

Updates

Our database is constantly updated as species are proposed, listed and delisted. If you address proposed and candidate species in your planning, this should not be a problem. However, we recommend that you get an updated list every 90 days. That would be May 4, 2015.

Appendix C
Biological Opinion of the West Sacramento General Reevaluation Report Project
West Sacramento, California

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Suite W-2605
Sacramento, California 95825-1846

In Reply Refer to:
FF08ESMF00-
2014-F-0434-2

JAN 06 2015

Ms. Alicia E. Kirchner
Chief, Planning Division
U.S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814

Subject: Formal Consultation on the West Sacramento Project General Reevaluation Report, Yolo County, California

Dear Ms. Kirchner:

This letter is in response to the U.S. Army Corps of Engineers (Corps) November 21, 2014, request for initiation of formal consultation with the U.S. Fish and Wildlife Service (Service) on the proposed West Sacramento Project General Reevaluation Report (West Sacramento GRR Project or project) in Yolo County, California. Your request, which included the November 2014 Biological Assessment, West Sacramento, California General Reevaluation Study and Section 408 Permission (biological assessment), was received by mail from the Corps by the Service on November 24, 2014. The biological assessment presents an evaluation of the West Sacramento GRR Project effects on species federally-listed under the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act). This response is provided under the authority of the Act, and in accordance with the implementing regulations pertaining to interagency cooperation (50 CFR 402).

The purpose of the West Sacramento GRR Project is to evaluate flood risk and provide improvements to flood management for the City of West Sacramento. It includes the Southport Project, which is to be completed as an early implementation project by the West Sacramento Area Flood Control Agency (WSAFCA) upon permission from the Corps, pursuant to Section 14 of the River and Harbors Act of 1899 (33 U.S.C. 408). Pursuant to 50 CFR 402.12(j), you submitted the biological assessment for our review and requested concurrence with the findings presented therein. These findings conclude that the proposed project may affect, and is likely to adversely affect the federally-threatened giant garter snake (*Thamnophis gigas*) (snake), federally-threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (beetle), and federally-threatened delta smelt (*Hypomesus transpacificus*) (smelt), as well as delta smelt critical habitat.

In considering your request, we based our evaluation of the biological assessment's findings on the following: (1) your consultation request and biological assessment received November 24, 2014; (2) site visits with Service, Corps, WSFACA, ICF International (ICF) representatives, and others; (3) numerous meetings with the Service, Corps, National Marine Fisheries Service (NMFS), WSAFCA, ICF, and others; (4) e-mail correspondence and other communication between the Service and the Corps; and (5) other information available to the Service. A complete administrative record is on file at the Sacramento Fish and Wildlife Office.

Consultation History

May 26, 2011	The Service attended a stakeholders meeting outlining preliminary plans for the Southport Early Implementation Project (Southport Project). The Southport Project was planned to proceed in advance of the other portions of the West Sacramento GRR Project.
August 15, 2011	WSAFCA held a stakeholder meeting and field visit for the Southport Early Implementation Project of the West Sacramento GRR Project, which the Service and the Corps attended.
February 12, 2013	The Corps provided the Service a draft biological assessment prepared by ICF for the Southport Project.
February 21, 2013	The Service provided comments on the draft biological assessment for the Southport Project. The comments centered on the need to include the delta smelt in the biological assessment.
June 3, 2013	The Service attended a meeting and site visit along with representatives from WSAFCA, ICF, NMFS, the California Department of Fish and Wildlife (CDFW), and others to review the proposed plans for the Southport Project.
June 5, 2013	The Service received a formal consultation request for the Southport Project from the Corps, dated June 4, 2013, along with a biological assessment.
August 27, 2013	The Corps hosted a meeting with the Service, NMFS, WSAFCA, and ICF. Mike Hendrick (NMFS) noted that NMFS would be preparing an insufficiency letter based on the project design noted in the Southport Project biological assessment.
September 4, 2013	Harry Kahler (Service) e-mailed Tanis Toland (Corps) noting that in lieu of impending changes to the Southport Project description, work on the consultation would be suspended until the project description was updated.
December 18, 2013	The Service attended a meeting at ICF discussing design modifications to the Southport Project that addressed concerns raised in NMFS insufficiency letter and previous meetings.

January 23, 2014	The Service received from the Corps a draft biological assessment for the West Sacramento GRR Project. The biological assessment did not contain information regarding the Southport Project.
March 20, 2014	The Corps hosted a meeting attended by the Service and NMFS to discuss the inter-relatedness of concurrent projects – the Southport Project, the West Sacramento West Sacramento GRR Project, the Sacramento River Bank Protection Project, and the American River Watershed Investigation, Common Features, General Reevaluation Report Project.
April 21, 2014	The Corps hosted a meeting attended by the Service and NMFS. The Service recommended that the Southport Project and the West Sacramento GRR Project be included in one biological opinion.
June 9, 2014	The Service received a request from the Corps to initiate formal consultation on the West Sacramento GRR Project. The initiation letter and biological assessment included the Southport Project.
June 19, 2014	The Service conveyed to the Corps via telephone and e-mail that effects to smelt and smelt critical habitat are quantified in terms of acreage, rather than in linear feet of river, as is the case for salmonids. The Service requested the Corps provide the acreage of smelt shallow water habitat that is to be affected by the West Sacramento GRR Project.
July 23, 2014	The Service sent a letter to the Corps detailing the need for more information regarding the amount of smelt habitat that will be impacted by the project and the amount of smelt habitat that will be created.
September 24, 2014	The Service received a response from the Corps, dated September 23, 2014, describing the amount of smelt shallow water habitat that will impacted by the West Sacramento GRR Project and the amount that will be created by the Southport Project.
October 16, 2014	The Corps held a meeting with the Service and NMFS, stating that they would be seeking incidental take coverage from Section 9 of the Act for the West Sacramento GRR Project as a whole, rather than taking a programmatic approach.
October 20, 2014	The Service downloaded an updated biological assessment from the Corps' FTP site.
October 27, 2014	The Corps sent via electronic mail a copy of a letter to the Service that officially withdrew the June 4, 2013, request for consultation for the Southport Project based on updated information regarding the West Sacramento GRR Project Plans.

November 21, 2014 The Corps sent via electronic mail a new request to initiate formal consultation for the West Sacramento GRR Project. An electronic link was included that provided access to the November 2014 final biological assessment.

November 24, 2014 The Service received by mail the signed request to initiate formal consultation for the West Sacramento GRR Project along with the biological assessment that addressed concerns raised by the Service and NMFS following the initiation request received June 9, 2014.

November 25, 2014 The Service requested and received, via electronic mail and telephone conversations, clarification regarding the identification and selection of potential sites for construction borrow material. The Corps explained that although potential borrow sites are identified for the West Sacramento GRR Project, the sites are subject to field verification for suitability.

BIOLOGICAL OPINION

Description of the Action

In 2006, a comprehensive evaluation of West Sacramento levees was completed by WSAFCA, in conjunction with the California Department of Water Resources, to determine the current level of flood protection provided by the levee system, to identify the magnitude and severity of levee deficiencies, and to propose flood risk reduction measures (HDR 2008). Results of the comprehensive evaluation revealed multiple levee deficiencies that would require substantial improvements to meet flood protection standards as implemented federally by the Corps. Furthermore, Senate Bill 5 signed in 2007 by Governor Arnold Schwarzenegger requires that urban areas such as West Sacramento achieve 200-year level flood protection by 2025.

The West Sacramento GRR Project is a Corps feasibility study of the improvements needed to provide West Sacramento with 200-year level flood protection. Its primary purpose is to assess and address the levee deficiencies on the nearly 50 miles of levees surrounding West Sacramento. Improvements to levees will be made incrementally, rather than altogether as one large project. In fact, three levee reaches with severe deficiencies have already been constructed by WSAFCA as Early Implementation Projects at the I Street Bridge, the CHP Academy, and The Rivers sites, all progressing in advance of the West Sacramento GRR Project. A fourth Early Implementation Project, known as the Southport Project, is included herein as part of the West Sacramento GRR Project.

West Sacramento is divided into two basins by levees, a north basin of about 6,100 acres and a south basin of about 6,900 acres. Deficiencies identified among different levee reaches of each basin generally include seepage, slope stability, erosion, and height insufficiencies (Figure 1). Construction will occur sequentially through each levee reach over a 19-year period, beginning with the Sacramento River South Levee. As a proposed Early Implementation Project, the Southport Project design along the Sacramento River South levee reach is more refined and detailed than the rest of the West Sacramento GRR Project. The proposed levee remediation measures vary among the nine levee reaches of the two basins and are summarized in Table 1.

Figure 1. West Sacramento General Reevaluation Report Project levee deficiencies, City of West Sacramento, Yolo County, California (Corps 2014b).

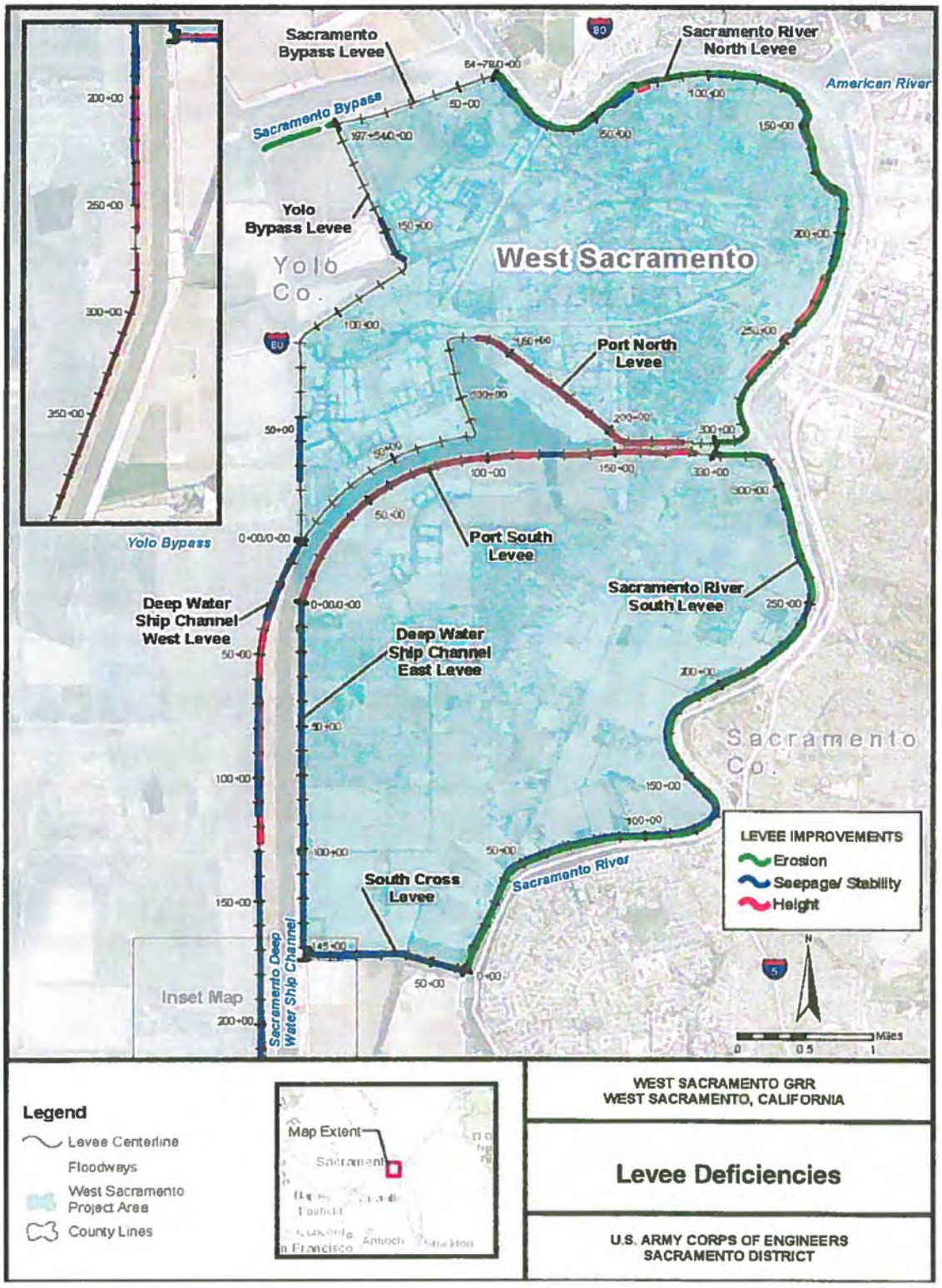


Table 1. Proposed remediation by levee reach, West Sacramento General Reevaluation Report, City of West Sacramento, Yolo County, California (Corps 2014b).

Levee Reach	Construction Sequence and Duration*	Seepage Remediation	Stability Remediation	Overtopping Remediation	Erosion Protection
	NORTH BASIN				
Sacramento River North	3 (2 years)	Cutoff Wall	Cutoff Wall	Levee Raise	Bank Protection
Port North	9 (2 years)	---	---	Floodwall	---
Yolo Bypass	4 (1 year)	Cutoff Wall	Cutoff Wall	---	---
Sacramento Bypass Training Levee	2 (1 year)	---	---	---	Bank Protection
	SOUTH BASIN				
South Cross	8 (2 years)	Stability Berm, Relief Wells	---	Levee Raise	---
Deep Water Ship Channel East	7 (3 years)	Cutoff Wall	Cutoff Wall	Levee Raise	Bank Protection
Deep Water Ship Channel West	5 (3 years)	Cutoff Wall	Cutoff Wall	Levee Raise	---
Port South	6 (1 year)	Cutoff Wall	Cutoff Wall	Levee Raise	---
Sacramento River South	1 (3 years)**	Setback Levee, Cutoff Wall, Seepage Berm	Setback Levee, Cutoff Wall, Seepage Berm	---	Setback Levee, Bank Protection

* Construction throughout all levee reaches is scheduled to occur sequentially over a 19-year period.

** Construction of flood-risk reduction measures will require 3 years; contouring and restoration of the associated offset floodplain area will require an additional 3 years.

Operation and Maintenance

As construction along levee reaches throughout the West Sacramento GRR Project area is completed, re-sloping and compacting will occur as needed. After construction, piezometers will be installed at various locations along the levees to monitor groundwater levels. Monthly visual inspections by driving along access roads on the crown will monitor levee conditions. Access roads will be maintained yearly with new aggregate base or substrate if necessary. Upon completion of construction, levees will be maintained per the approved operations and maintenance (O&M) manual applicable to each levee reach throughout the West Sacramento GRR Project area. Levees

are expected to be mowed up to four times a year to control vegetation. Herbicide applications will be used as needed. Burrowing mammal activity will be controlled monthly by baiting with pesticides.

Details of each specific construction measures are described below, followed by descriptions of the deficiencies and corrective construction measures for each levee reach of the West Sacramento GRR Project.

Construction Methods

Several construction methods will be used to alleviate seepage, slope stabilization concerns, overtopping, and erosion. In addition, some general construction measures will be implemented throughout the West Sacramento GRR Project, regardless of the specific corrective measures that will be applied. Flood risk reduction measure construction activities will primarily occur during the typical construction season for flood control projects, April 15 to October 31.

General Construction Measures

Standard Levee Footprint
On all levees that are out of compliance with Corps policies, a standard levee footprint will be established during construction. The standard levee footprint consists of a 20-foot crown with 3 horizontal:1 vertical (3H:1V) levee slopes. If a 3H:1V landside slope is not possible given the site-specific conditions, then a minimum slope of 2H:1V will be established. Also, a 20-foot-wide maintenance access buffer will be established on both the landside and waterside levee toes. If 20 feet is not possible, given site-specific conditions, then a minimum of 10 feet will be designed as a buffer. All encroachments into the levee footprint will be brought into compliance with Corps policy or removed. Encroachments include buildings, certain vegetation, utility poles, and pump stations, as well as underground pipes, conduits, and cables. Bringing into compliance generally means relocation, reconstruction, or retrofitting. Any utility lines found within the levee footprint will either be relocated above the new levee prism, or equipped with positive closure devices for through-lines. Private encroachments will be removed by the non-Federal sponsor (WSAFCA) or property owner prior to construction.

Vegetation Policy Compliance
The Corps has established and plans to follow guidelines for landscape planting and vegetation management at levees, floodwalls, embankment dams, and appurtenant structures, as described in Engineering Technical Letter (ETL) 1110-2-583 (Corps 2014a). The primary purpose of the vegetation-free zone is to provide a reliable corridor of access to, and along, flood control structures. A three-dimensional vegetation-free zone will surround all levees, floodwalls, embankment dams, and critical appurtenant structures in all flood damage reduction systems. The vegetation-free zone applies to all vegetation except perennial grass species, which are permitted for the purpose of erosion control. The vegetation free zone extends 15 feet from both landside and waterside levee toes, and 8 feet vertically.

A variance from the vegetation policy is being sought for work along the Sacramento River North and Sacramento River South levee reaches. Along much of the Sacramento River within the project area, the distance between the levee toe and the river waterline is sufficient to allow vegetation to remain along the riverbank without a variance. However; in some places, trees will be thinned along

the Sacramento River North Reach to allow placement of rock slope protection, and therefore would require a variance.

Borrow Materials
A maximum estimate of 9 million cubic yards of borrow material will be needed to construct the West Sacramento GRR Project. Because most of the project is in the preliminary stages of design, detailed studies of each levee reach borrow needs have not been completed. A worst case scenario was evaluated for the volume of borrow material needed. Actual volumes exported from any single borrow site may be adjusted to match demands for fill.

To identify potential locations for borrow material, soil maps and land use maps were obtained for a 20-mile radius surrounding the West Sacramento GRR Project area (Figure 2). The criteria used to determine potential locations were based on current land use patterns, soil types from U.S. Soil Conservation Service (SCS), and the Corps' criteria for material specifications. The data from the land use maps and the SCS will be field verified. To reduce impacts, the closest identified potential borrow sites will be evaluated for suitability first, with additional sites being evaluated as needed. Any identified potential borrow sites outside of the City of West Sacramento that may affect federally-listed species, or may adversely modify designated federally-listed species critical habitat, will not be used for borrow material. Borrow sites will only be obtained from willing sellers.

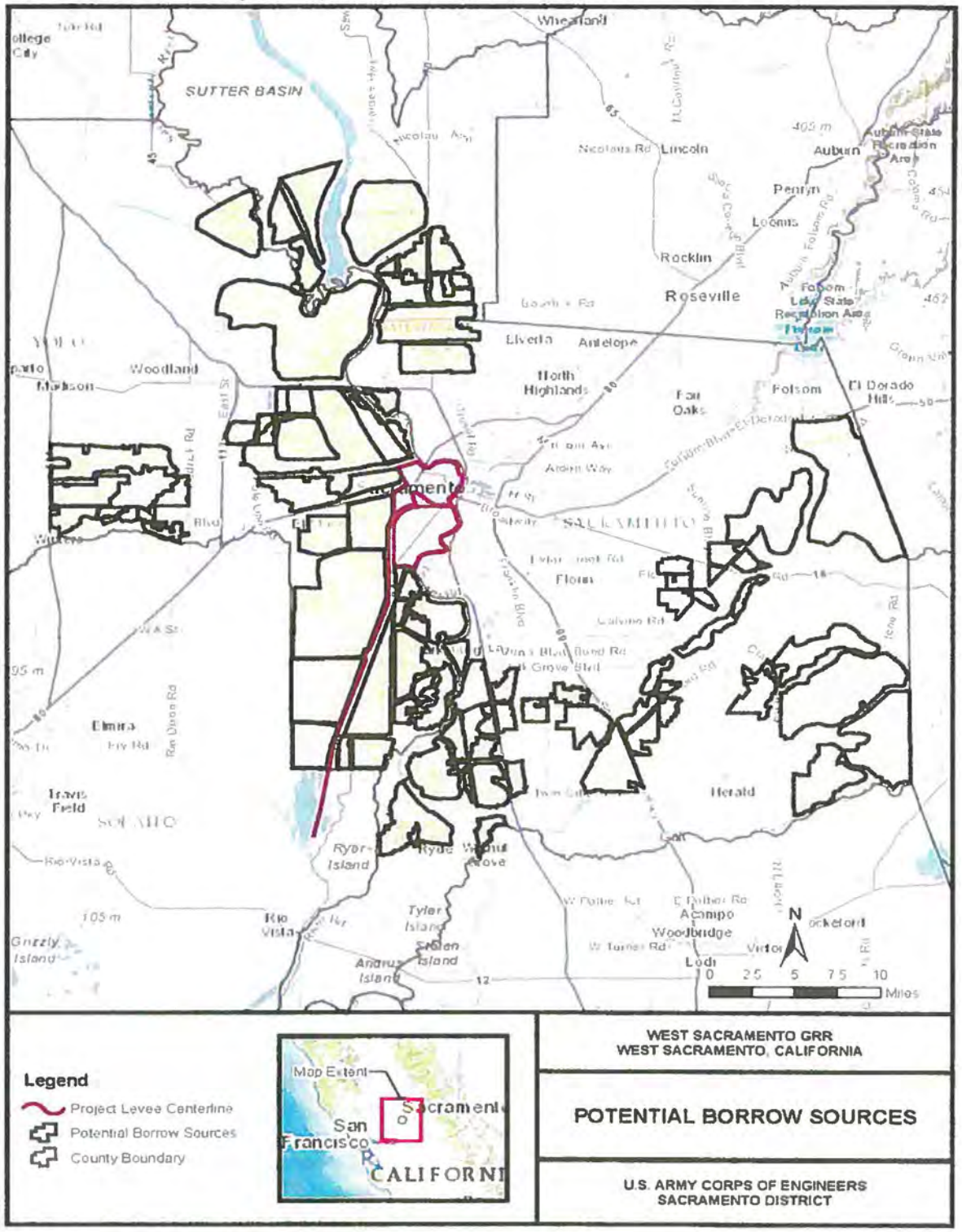
The excavation limits on the borrow sites will provide a minimum buffer of 50 feet from the edge of the site boundary. From this setback, the slope from the existing grade down to the bottom of the excavation will be no steeper than 3H:1V. Excavation depths from the borrow sites will be determined based on available suitable material and local groundwater conditions. The borrow sites will be stripped of top material and excavated to appropriate depths. Once material is extracted, borrow sites will be returned to their existing use whenever possible, or these lands could be used to mitigate for project effects, if appropriate.

Seepage Remediation and Slope Stabilization

Slurry Cutoff Walls
Conventional Open Trench Cutoff Wall: A 3-foot-wide trench is dug from the top of the levee centerline up to 85 feet deep into the substrate materials. As the trench is excavated, it is filled with a temporary bentonite slurry to prevent cave-ins. To form the wall, the soil from the excavation is mixed with hydrated bentonite or cement and backfilled into the trench, displacing the temporary slurry. Once the permanent soil-slurry mix is hardened, the levee embankment is reconstructed and capped with an impervious or semi-impervious soil. Heavy equipment to be used for cutoff walls includes bulldozers, haulers, excavators, scrapers, rollers, and water trucks.

Clamshell Method Cutoff Wall: The clamshell method is similar to the conventional open trench method, yet also employs a dragline crane with a clamshell bucket. The initial trench is excavated and backfilled as described for the conventional open trench method, yet the dragline crane and clamshell bucket is used when the trench becomes too deep to complete conventionally. The bentonite grout is mixed with the native soil and poured in the trench as the clamshell is removed. Cement is added to the mix at times to add strength and decrease curing time.

Figure 2. Potential Locations for Borrow Material within a 20-mile Radius of the West Sacramento General Reevaluation Report Project action area, California, 2014.



Deep Soil Mixing Cutoff Wall: At the wall site a crane with two to four augers will drill through the levee crown to a depth of up to 140 feet. High-pressure hoses will carry the grout from the batching plant to the wall site, where the grout is injected through the augers and mixed with native soils. As the drilling apparatus progresses along the levee crown, a series of overlapping columns of grout mixture are left to form the wall.

Because large quantities of a cement-bentonite grout are used, a contractor-provided onsite batch plant is necessary. The batch plant will consist of an aggregate storage system, an aggregate rescreen system if needed, a rewashing facility if needed, the batching system, cement storage, ice manufacturing, and the grout mixing and loading system. All aggregate used within the batch plant operations will be obtained from local commercial sources and delivered to the site. When the wall has hardened it is capped and the levee embankment is reconstructed with impervious or semi-impervious materials.

Jet Grouting: Jet grouting typically is used in constructing a slurry cutoff wall to access areas other methods cannot. Jet grouting will be used around existing utilities not proposed for removal, and at bridges along the project levees. It involves injecting fluids or binders into the soil at very high pressure to a maximum depth of about 130 feet. The injected fluid can be grout; grout and air; or grout, air, and water. Jet grouting breaks up soil and, with the aid of a binder, forms a homogenous mass that solidifies over time to create a mass of low permeability.

Equipment required for jet grouting consists of a drill rig complete with a high flow pump and portable batch plant. Jet-grouted columns range from 1 to 16 feet in diameter and typically are interconnected to form cutoff barriers or structural sections. A construction crew usually consists of a site supervisor, pump operator, batch plant operator, chuck tender, and driller, and can construct two 6-foot diameter 50-foot columns per day consisting of about 100 cubic yards of grout injected per 8-hour shift.

To provide a wide enough working platform on the levee crown, the upper portion of some segments of the levee may require degradation with a paddle wheel scrapper. Material will be scraped and stockpiled at a nearby stockpile area. Hauling at the work area will involve scraper runs along the levee to the staging area, and grout, bentonite, and water deliveries to the batch plant.

Landside Berms

Seepage Berm: Seepage berms are constructed in areas where geotechnical investigations indicate that safely releasing seepage water on the landside is more appropriate than a cutoff wall. Generally a seepage berm extends outward from the landside toe of the levee to a width of 70 to 100 feet. The berm is about 5 feet high at the levee toe and tapers to about 3 feet high at the berm toe. The length of the berm is dependent upon the levee seepage concerns.

To construct a seepage berm, the ground is first cleared, grubbed and stripped. If the soil is found to be adequate for berm construction during levee degradation, it will be stockpiled for use later. Otherwise, soils from nearby borrow pits will be used, or if necessary, trucked onsite from other locations. A bulldozer and front-end loader will be used at borrow sites to load haul trucks. Motor graders will be used onsite to grade materials dumped by haul trucks. The fill material is placed in 1- to 2-foot lifts for compaction by sheepsfoot rollers. The width of the berm is dependent on the permeability of the fill material. Water trucks are used to aid compaction and decrease dust emissions. Upon completion, berms are hydroseeded with a native seed mix of grass and forbs.

Additionally, some seepage berms are constructed with a drainage relief trench at the toe of the berm. Generally, a drainage trench is made with loose gravel or sand beneath the toe of the berm materials to allow the drainage of permeated water. Also, a 15-foot vegetation free zone running parallel to the seepage berm is designed to allow O&M access.

Stability Berm: Stability berms are constructed along the landside toe of levees with the purpose of providing support to the levee as a buttress. The height of a stability berm is usually 2/3 the height of the levee, and the length is dependent on the structural needs of the levee reach. The construction of stability berms is similar to the construction of seepage berms. Plans for the South Cross levee reach include a stability berm.

Adjacent Levees

Adjacent levee designs essentially widen the existing levee, thereby allowing the adjacent levee geometry to be restructured on the landside to a 3H:1V slope, and also adding stability. Because adjacent levees are constructed on the landside, the waterside levee slopes are generally left with existing vegetation in place.

The first construction phase includes clearing, grubbing, and stripping the work site and any construction staging areas, if necessary. A trapezoidal trench is cut at the toe of the slope and the levee embankment then is cut in a stair-step fashion to allow the new material to be keyed into the existing material. As with berm construction, bulldozers excavate and stockpile material from a nearby borrow site. Front-end loaders load haul trucks with the borrow material, and the haul trucks subsequently transport it to the adjacent levee site. After the haul trucks dump the material, dozers level it as needed. Sheepsfoot rollers compact the material, and water trucks distribute water over the material to ensure proper moisture for compaction. The landside levee will be graded at a 3H:1V slope, and the levee crown will be at least 20 feet wide. The slope may be track-walked with a dozer. The levee crown will be finished with an aggregate base or paved road, depending on the type and level of access desired. Either condition will require importation of material with dump trucks, placement with a loader and motor grader, and compaction. A paver will be required for asphalt placement.

Sheet Pile Wall

A sheet pile wall is proposed at the Stone Locks to tie together the levees on both sides of the Barge Canal at the end of the Sacramento River Deep Water Ship Channel. A trench will be excavated along the sheet pile alignment to allow the pile to be driven to the proposed depth. A driving template fabricated from structural steel will control the alignment as the sheet pile is installed. A hydraulic or pneumatically operated pile driving head attached to a crane drives the sheet pile into the levee crown to the desired depth (up to 135 feet). An additional crane or excavator may be used to facilitate staging of the materials. The conditions of the site, driving pressure, hydrostatic loads, and corrosion considerations will determine the thickness and configuration of the sheet piles.

Relief Wells

Relief wells are used to address underseepage and will be applied only on site-specific conditions rather than as a segment-wide application. They will be located along adjacent and setback levee toes in the South Basin and only in segments where geotechnical analyses have identified continuous sand and gravel layers and the presence of an adequate impermeable layer. Relief wells are passive systems that are constructed near the levee landside toe to provide a low-resistance pathway for under-seepage to exit to the ground surface in a controlled and observable manner. Relief wells

generally are spaced at 50- to 150-foot intervals, dependent on the amount of underseepage, and extend to depths of up to 150 feet. Areas for relief well construction are cleared, grubbed, and stripped. During relief well construction, a typical well-drilling rig will be used to drill to the required depth and construct the well beneath the ground surface. The drill rig likely will be an all-terrain, track-mounted rig that could access the well locations from the levee toe.

Areas along the levee toe may be used to store equipment and supplies during construction of each well. Construction of each well and the lateral drainage system typically takes 10 to 20 days. Additional time may be required for site restoration.

Overtopping Remediation

Levee Height Raise
Height deficiencies are constructed as needed following the completion of cutoff wall installation and levee geometry corrections. The required additional materials will come from identified borrow pits, stockpiled in staging areas, and hauled to the site with trucks and front end loaders. The levee will be hydroseeded once construction is complete.

Floodwalls
Floodwalls are proposed along the Port North levee around the Port of West Sacramento. To begin the floodwall construction, the area will be cleared, grubbed, stripped, and excavation will occur to provide space to construct the footing for the floodwall. The floodwall largely will be constructed from pre-fabricated materials, although it may be cast or constructed in place, and will be constructed almost completely upright. The height of the floodwalls varies from 1 to 4 feet, as required by water surface elevations. The waterside slope will be re-established to its existing slope and the levee crown will grade away from the wall and be surfaced with an aggregate base.

Erosion Protection

Levee Slope Revetment
The primary erosion protection measure consists of waterside armoring of the levees to prevent erosion and subsequent damage to the levee. This measure consists of placing rock revetment on the river bank, and in some locations on the levee slope, to prevent erosion. The extent of the revetment will be based on site-specific analysis. Along the Sacramento Bypass Training levee, revetment will be placed on both sides of the levee to protect the levee in place when the Sacramento and Yolo Bypasses contain water. When necessary, eroded portions of the bank will be filled and compacted prior to the rock placement. The sites will be prepared by clearing and stripping the site prior to construction. Rock revetment will be placed around existing trees on the lower portion of the slope. Trees on the upper portion of the slope will be removed during degrading of levees for slurry cutoff walls and bank protection will be placed following reconstruction of the levee. Temporary access ramps will be constructed, if needed, using imported borrow material that will be trucked on site.

Revetment will be imported from an offsite location via haul trucks or barges. Revetment transported by haul trucks will be temporarily stored at a staging area located in the immediate vicinity of the construction site. A loader will be used to move revetment from the staging area to an excavator that will place the material on site. Rock required on the upper portions of the slopes

will be placed by an excavator located on top of the levee. Rock placement from atop the levee will require one excavator and one loader for each placement site.

Revetment transported by barges will not be staged, but placed directly on site by an excavator. Rock required within the channel, both below and slightly above the water line at the time of placement, will be placed by an excavator located on a barge. The excavator will construct a large rock berm in the water up to an elevation slightly above the mean summer water surface. Construction will require two barges: one barge will carry the excavator, while the other barge will hold the stockpile of rock to be placed on the channel slopes.

The bank protection will be placed on the existing bank at a slope varying from 2V:1H to 3V:1H depending on site specific conditions. After rock placement is complete, a small planting berm will be constructed in the rock, when feasible, to allow for some revegetation of the site outside of the vegetation free zone required by ETL 1110-2-583.

Levee Biotechnical Measures
Biotechnical measures will be implemented along lower velocity reaches to preserve existing vegetation. Biotechnical measures include the use of plant material and minimal amounts of rock to stabilize the eroded slope and prevent further loss of levee materials.

Setback Levee
A setback levee is an entirely new section of levee built at some distance inland from the existing levee section to be replaced. The new levee section is constructed to meet current design standards for height and geometry. Similar to the levee slope stabilization methods, a setback levee construction site is first cleared, grubbed, stripped, and all encroachments into the alignment are removed. Materials are stockpiled at staging areas after being removed and hauled from borrow sites. Heavy equipment is used to manipulate materials on site. Once the designed height is reached, a slurry cutoff wall is put in the levee crown via the conventional slot trench method or clamshell method, depending on the necessary depth. Topsoil is added and the new levee section is hydroseeded. An all-weather, aggregate base is constructed on the levee crown.

North Basin Levee Reaches

Table 2 shows the extent to which each construction measure will occur within each levee reach in the North Basin. Refer to Figure 1 for the approximate location of each proposed improvement.

Sacramento River North
The Sacramento North levee reach extends 5.5 miles from the Sacramento Bypass southward to the William Stone lock structure at the north end of the Sacramento River Deep Water Ship Channel. It is scheduled as the third reach for construction of the project. Slurry cutoff walls will be installed to different depths along the reach to address seepage and slope stability concerns. The conventional open trench method will be used to install walls up to 85 feet deep. A deep slurry method will be used for walls that are installed to a depth greater than 85 feet. Also, to alleviate height deficiencies in some areas, the levee geometry will be restructured with fill materials. Erosion concerns along nearly the entire length of the Sacramento North levee reach will be addressed by bank protection measures. In general, bank protection will involve the placement of rock on the existing bank at a slope between 2V:1H to 3V:1H, depending on specific site conditions.

Table 2. The construction length, improvement, and construction measure of each levee reach within the North Basin of the West Sacramento General Reevaluation Report, City of West Sacramento, Yolo County, California (Corps 2014b).

North Basin Levee Reach	Length of Levee Reach (feet)	Length of Measure (feet)	Improvement	Measure
Sacramento River North Levee and Stone Lock Closure	31,270	30,000	Erosion	Bank Protection
		11,000	Seepage	Slurry Cutoff Wall to 30 feet
		1,500		Slurry Cutoff Wall to 80 feet
		500		Slurry Cutoff Wall to 45 feet
		5,500		Slurry Cutoff Wall to 110 feet
		4,600	Height	Embankment Fill
		550	Stone Lock Closure	Embankment Fill, Sheet Pile Wall
Port North Levee	23,225	8,500	Height	Floodwall, 4-10 feet
		14,000	Height	Embankment Fill
Yolo Bypass Levee	19,749	2,500	Seepage	Slurry Cutoff Wall to 40 feet
		2,000	Seepage	Slurry Cutoff Wall to 100 feet
Sacramento Bypass Training Levee	3,000	3,000	Erosion	Bank Protection

Additionally, the William Stone lock structure will be closed and the Sacramento River Deep Water Ship Channel barge canal will be blocked from the Sacramento River via a new levee embankment and sheet pile wall. A coffer dam will be constructed on the east side of the lock structure, and the new levee and sheet pile wall will be built within the dry area. The new levee will permanently connect the North and South Basins. It will require the relocation of three utility poles, two storm drains, and the removal of concrete infrastructure.

Port North

The Port North levee work is scheduled as the final reach of the West Sacramento GRR Project, extending 4.9 miles west from the William Stone lock structure at the Sacramento River. Work through the levee reach generally involves the construction of flood walls through the Port of West Sacramento to alleviate overtopping concerns (see Figure 1).

Yolo Bypass

To address seepage and slope stability problems, slurry cutoff walls will be constructed at two points along the Yolo Bypass levee. A conventional open trench cutoff construction method will be used

to install cutoff walls in two places to depths of 40 feet and 100 feet. The Yolo Bypass levee is scheduled as the fourth levee reach to be addressed in the West Sacramento GRR Project.

Sacramento Bypass Training Levee
Most of the south levee of the Sacramento Bypass was reconstructed as the CHP Academy Early Implementation Project in 2011. However, a 3,000-foot portion of the south levee that lies to the west of the CHP Academy Project is scheduled as the second levee reach to be addressed by the current West Sacramento GRR Project. Bank protection is proposed to address erosion issues.

South Basin Levee Reaches

Table 3 shows the extent to which each construction measure will occur within each levee reach in the South Basin. Refer to Figure 1 for the approximate location of each proposed improvement.

South Cross
The South Cross levee reaches west from the Sacramento River at the Riverview area of West Sacramento, to the Sacramento River Deep Water Ship Channel. Plans include a landside berm to address stability issues and a levee raise to address height concerns. It is scheduled as the eighth of the nine levee reaches to be addressed by construction under the project.

Sacramento River Deep Water Ship Channel East
The east levee along the Sacramento River Deep Water Ship Channel protects the South Basin from inundation. Noted deficiencies in the east levee are seepage, slope stability, and insufficient height. Slurry cutoff walls will be installed to address the seepage and slope stability issues. In reconstructing the levee prism to address height concerns, the irrigation ditch at the landside toe of the levee will be moved landward, and will be replaced by two 48-inch diameter pipes in the area adjacent to existing housing development. The Sacramento River Deep Water Ship Channel east levee is scheduled as the seventh levee reach for construction of the project.

Port South
The Port South levee has overtopping and seepage issues, as well as slope stability problems in a few areas. To alleviate the stability and seepage concerns, a seepage berm will be constructed. Also, relief wells will be added in certain areas to control additional seepage. The levee will be raised as well to address overtopping concerns. The Port South levee will be the sixth levee reach scheduled for construction in the project.

Sacramento River Deep Water Ship Channel West
The west levee along the Sacramento River Deep Water Ship Channel provides a barrier between the ship channel and the Yolo Bypass. As a worst-case scenario, levee deficiencies at various locations along nearly 19 miles of the levee will be addressed. Slurry cutoff walls and seepage berms will be constructed to control seepage issues, and the levee will be raised to address overtopping concerns. On the west side of the levee, facing the Yolo Bypass, rock slope protection will be used to address erosion concerns. The Sacramento River Deep Water Ship Channel west levee is scheduled as the fifth reach for construction in the project.

Table 3. The construction length, improvement, and construction measure of each levee reach within the South Basin of the West Sacramento General Reevaluation Report, City of West Sacramento, Yolo County, California (Corps 2014b).

South Basin Levee Reach	Length of Levee Reach (feet)	Length of Measure (feet)	Improvement	Measure
South Cross Levee	6,273	1,100	Stability/Height	Stability Berm Embankment Fill
		5,000	Seepage/Height	Relief Wells Embankment Fill
Deep Water Ship Channel East Levee	17,171	1,500	Seepage	Slurry Cutoff Wall to 120 feet
		7,100	Seepage	Slurry Cutoff Wall to 130 feet
		2,600	Height	Embankment Fill
Port South Levee	16,262	15,600	Height	Embankment Fill
		1,000	Seepage	Slurry Cutoff Wall to 70 feet
Deep Water Ship Channel West Levee	100,260	9,000	Height/Seepage	Slurry Cutoff Wall to 85 feet
		7,000	Height/Seepage	Slurry Cutoff Wall to 50 feet
		9,000	Height/Seepage	Slurry Cutoff Wall to 75 feet
		75,300	Height	Embankment Fill
		100,000	Erosion	Bank Protection
Sacramento River South Levee	31,000	31,000	Seepage/Erosion	Setback Levee Bank Protection Slurry Cutoff Wall to 80 feet 70-foot Wide Seepage Berm

Sacramento River South – *The Southport Project*

The Southport Project, an Early Implementation Project along the Sacramento River South levee, will be the first levee reach to be addressed in the project. Construction is scheduled to begin in 2015 by the city of West Sacramento, in advance of the overall West Sacramento GRR Project. The Southport Project is proposed to construct flood risk reduction measures along the Sacramento River South levee in order to provide 200-year level of performance consistent with the State mandate for urbanized areas, as well as to provide opportunities for ecosystem restoration and public recreation.

The Southport Project is divided into eight segments, A-G, from south to north (Appendix A). Table 4 outlines the construction measures to be built in each section.

Table 4. Levee remediation measures of the Southport Project portion of the West Sacramento GRR Project, West Sacramento, Yolo County, California.

Southport Segment	Length (linear feet)	Remediation Measures
A	4,830	Slurry cutoff wall
B	115	Slurry cutoff wall
	1,955	Slurry cutoff wall and seepage berm
	3,490	Setback levee, slurry cutoff wall, seepage berm, bank stabilization at levee breach
C	4,490	Setback levee, slurry cutoff wall, seepage berm, toe rock and bank stabilization at levee breaches
	940	Setback levee, slurry cutoff wall, seepage berm, bank stabilization at erosion sites, waterside toe rock upstream and downstream of erosion sites
D	1,985	Setback levee, slurry cutoff wall, waterside toe rock upstream of erosion sites
E	995	Setback levee and slurry cutoff wall
	2,297	Setback levee, slurry cutoff wall, and seepage berm
F	5,583	Setback levee, slurry cutoff wall, seepage berm, bank stabilization and waterside toe rock at decommissioned levee breach, waterside toe rock and bank stabilization at other decommissioned levee breach
G	2,795	Slurry cutoff wall and bank stabilization at erosion site

The Southport project involves the following elements:

- Construction of flood risk reduction measures, including seepage berms, slurry cutoff walls, setback levees, rock and biotechnical slope protection, and encroachment removal;
- Partial degrade of the existing levee, forming a decommissioned "remnant levee;"
- Construction of an offset floodplain area using setback levees, supplying about 160 acres in total for subsequent habitat restoration of riparian and floodplain habitats;
- Construction of breaches in the remnant levee to open up the offset areas to Sacramento River flows;
- Road construction;
- Drainage system modifications; and
- Utility line relocations.

The levee flood risk reduction measure footprint includes the following elements: a waterside O&M easement where available, the levee from toe to toe, a seepage berm, and the landside O&M easement. The waterside and landside O&M easements will be assumed to be 20 feet wide and

unpaved. The landside O&M easement follows the toe of the levee or the landside toe of seepage berms, where present. The utility corridor is included largely within the Village Parkway right-of-way. In Segment G, where existing residences are close to the existing levee, the landside O&M easement will vary from about a few feet to 100 feet between the proposed flood risk reduction measure toe and the existing residential lot lines. In Segment A, the landside O&M easement coincides with South River Road. For segments where a suitable impermeable tie-in layer was not identified from the geotechnical explorations, a seepage berm will be constructed. Where a tie-in layer was located, a cutoff wall at the associated depth will be constructed. For levee reaches where a seepage berm will be constructed to address underseepage, a shallow cutoff wall also will be installed in lieu of an inspection trench.

A setback levee will be constructed in levee Segments B through F. A setback levee is an entirely new section of levee constructed at some distance behind the landside of the existing levee. The obsolete levee sections will remain in place and be breached to create and offset area containing two separate floodplains for the Sacramento River. The new section of levee will be tied into the existing levee to the south and north and become the Federal project levee. Once the foundation of the new setback is built up to a suitable elevation, a slurry cutoff wall will be constructed using either the conventional slot trench method or clamshell method.

The new levee section will be constructed to meet current design standards, including height and slope requirements. Levee slopes will be graded to a 3H:1V slope, and a crown at least 20 feet wide created. Topsoil will then be placed on the levee slopes and hydroseeded. For the purpose of levee inspection and emergency vehicle access, an aggregate base, all-weather levee-top patrol road will be constructed. Seepage berms for the Southport Project will vary from 50 to 100 feet in width. Lateral length will depend on seepage conditions along the area of identified levee deficiency.

Southport Project Bank Erosion Sites

Three bank erosion sites requiring repairs were identified in the project reaches along the Sacramento River; two sites are in Segment C and the third site is in Segment G (Appendix A). The Segment C sites will not be subject to the Corps vegetation policy, as they will be on the remnant levee; however, the Segment G site will be located on the Federal project levee and will comply with the vegetation policy. The repairs at all three sites are designed to protect against erosional forces that threaten levee stability, such as wind, waves, boat wake, and fluvial forces.

Southport Project Remnant Levee Sites

The two erosion sites on the remnant levee are C1 and C2. Once the setback levees for the Southport Project are complete, the existing levee in Segment C will no longer be part of the Federal project levee. Site C1 has a top length of 160 linear feet, while Site C2 has a length of 547 linear feet. Remediation at Site C1 will address a scour hole that has formed on the slope between elevations of -33 feet, North American vertical datum of 1988 (NAVD 88), and +11 feet NAVD 88, as well as slumping that has occurred at the base of the slope. Remediation at Site C2 will address general erosion problems that have been created by wave erosion.

Design and Construction: Erosion site repairs on the remnant levee are designed both to control erosion and to maintain existing vegetation and instream woody material. This will be accomplished by incorporating rock benches that serve as buffers against erosion while providing space for planting riparian vegetation and creating a platform to support aquatic habitat features (Appendix A). Rock will be placed onto the levee slope from the waterside by means of barges; one barge will

hold the stockpile of rock to be placed, and a second barge will hold the crane that will place the rock on the channel slopes. A backhoe will be used from the bank to adjust the rock. Clean rock fill will be placed over existing riprap between elevations of -33 feet NAVD 88 and +5 feet NAVD 88, and type C graded stone will be placed over the clean rock fill in a 2.5-foot thick layer with a 2H:1V slope from the toe of the slope to an elevation of +7 feet NAVD 88. The clean rock fill and graded stone at the top of the erosion site will be placed to form a planting bench at an elevation of +7 feet NAVD 88 to match the average annual low-water surface elevation, and the bench will have an average width of about 10 feet. At Site C1, stone will be placed at the upstream and downstream ends of the site to address problems created by a scour hole along the site.

After the rock is placed along the slope of the erosion sites, a 1-foot thick layer of 0.75-inch crushed clean rock will be placed at the upslope end of the stone bench to create a filter between the topsoil and the stone bench. Topsoil then will be placed above the newly constructed bench at a 3H:1V slope to meet the existing bank, and coir fabric will be placed over the soil to keep it in place. Topsoil will be placed from a barge, similar to the process for placing the rock. Pole plantings will be hand-placed in the planting bench between elevations of +7 feet NAVD 88 and +11.5 feet NAVD 88. Beaver fencing will be installed at the upslope and downslope extents of the topsoil installation. Instream woody material will be anchored along the remnant levee erosion sites to achieve at least 40% shoreline coverage, and placed between 1 and 3 feet below the elevation of the average annual low water surface. Instream woody material will likely come from trees removed in other portions of the project area, and will be selected based on suitability for the site. Existing vegetation and riprap at the erosion site will be retained.

The two erosion sites on the remnant levee are located on the outer bank of a bend in the river and are therefore subject to greater erosive forces. Rock will be placed along the toe of the bank (toe rock) at both sites, as well as upstream and downstream of the erosion sites to further protect the bank of the remnant levee. The toe rock will begin about 850 feet upstream of Site C1, will extend through both erosion sites, and will terminate about 300 feet downstream of Site C2. Portions of this area are currently riprapped, and the additional toe rock to be placed will be limited to areas where there is currently no rock below an elevation of +7 feet NAVD 88.

Southport Project Active Levee Erosion Site

Site G3 is located in Segment G and therefore will remain as part of the Federal project levee. Site G3 includes 410 linear feet of repairs to the top of the erosion scarp and the creation of a planting bench and vegetated slope to protect against boat wake and fluvial erosion.

The design, construction equipment, methods, and materials for Site G3 are similar to those described for Sites C1 and C2. However, Site G3 will require additional rock armoring and soil fill (up to elevation +25 feet NAVD 88) to repair the erosion scarp and meet Federal levee protection standards. The proposed design includes riprap toe protection, earth and rock fill to restore the levee prism between elevation -10 feet NAVD 88 and +25 feet NAVD 88, a soil-covered 10-foot-wide planting bench (10H:1V slope) and bank (3H:1V slope) planted with pole cuttings and large container plantings, and instream woody material anchored between 1 and 3 feet below the elevation of the average annual low water surface. The planting bench will be 15 feet outside the minimum levee template.

Southport Project Encroachment Removal
Levee standards for vegetation and encroachments require removing encroachments, such as structures, levee penetrations (e.g., pipes, conduits, cables), power poles, pump stations, and similar features, from the levee footprint. Encroachment removal includes demolition, relocation, retrofitting, or reconstruction as appropriate on a case-by-case basis. Existing pilings within the river at Oak Knoll Bend also will be removed.

Encroachment removal techniques will be implemented based on the needs of the specific encroaching feature. Smaller encroachments will be removed, relocated, or retrofitted by manual labor of small crews (about 2 to 10 workers) using hand tools. Larger encroachments require machinery such as an excavator, skid-steer, and bulldozer. The removal of sections of two-lane asphalt road will be required. Piling removal requires a barge with a crane for removal or cutting at the mud line. Dump trucks will be used for hauling and disposal of removed material at an offsite, permitted commercial source within 10 miles of the project area.

Southport Project Remnant Levee Degrade
With the construction of the setback levee, most of the decommissioned levee in Segments B through F will be degraded to provide additional borrow material for constructing seepage berms or for reclamation of other borrow areas. The remnant levee in Segment E will remain to maintain access to Sherwood Harbor Marina and Sacramento Yacht Club. Similarly, although the roadway will be removed up to the Sacramento Yacht Club, the levee will not be degraded on Segment F south of breach N2 to help protect the marinas during high flow events.

Prior to excavation, the area to be degraded will be cleared, grubbed, and stripped. The remnant levee will be degraded to an elevation of +30 feet NAVD 88, with a crown width of 20 feet and a landside slope of 3H:1V. Front-end loaders will load haul trucks with the excavated material. Haul trucks will transport the material to stockpile areas in the staging areas for later use for berms, or to borrow areas for use in site restoration. Material used for borrow area restoration will be spread evenly using motor graders and compactors. Disturbed areas will be planted as part of the offset area restoration plantings, and an unpaved O&M corridor will be established along the landside toe of the remnant segments.

Southport Project Levee Breaches
Portions of the remaining decommissioned levee will be breached to allow Sacramento River flows into two separate floodplain areas within the offset area during high flow events (Appendix A). The northern floodplain area breaches, from north to south, are North 1 (N1) and North 2 (N2) (both in Segment F), and the southern floodplain area breaches, from north to south, are South 1 (S1) (Segment C), South 2 (S2) (Segment C), and South 3 (S3) (Segment B). Construction of the breaches will occur during the summer–fall period to comply with Central Valley Flood Protection Board regulations. Both floodplain areas will be distinct from the existing Bees Lakes, which also will remain on the waterside of the new setback levee alignment.

Breaches S3 and N1 will be created in the third construction year and the remaining breaches will be completed 2 years later. Staggering the breaches will allow offset area restoration vegetation to establish before being exposed to flows. Until breaches S1, S2 and N2 are constructed, culverts will be installed at their proposed locations to drain the offset floodplain area. The culverts also will balance the hydraulic pressure on both sides of the degraded levee and to minimize fish stranding. Each culvert will be 54 inches in diameter and about 140 feet long. The culverts will be placed at

about +7 NAVD in order to fully drain the offset floodplain area. To construct the breaches, the existing levee will be degraded with excavators to an elevation of +10 feet NAVD 88. Existing revetment in good condition will be retained below +10 NAVD 88. The breach shoulders will be armored with rock from the existing riprap on the waterside, over the degraded remnant levee crown, and down the landside slope. A 25-foot riprap apron then will extend out from the landside toe of the breach shoulder at an elevation of roughly +10 NAVD 88, as well as from the toe of the shoulder in the breach. All rock for the shoulder and apron armoring will be placed in a layer about 2.5 feet thick.

In-water construction activities are scheduled between July 1 and October 31, when water elevations in the Sacramento River along the project area are typically at the average annual low water elevation of +6.7 feet NAVD 88 to +7.1 feet NAVD 88. Installation of temporary cofferdams may be necessary prior to culvert installation to prevent river flows from entering the construction area. At a minimum, sandbags will be used to construct the cofferdam and water will be pumped out of the inundated construction area. Cofferdams will be constructed using sheet pile walls or other methods, and typically will extend up- and downstream of the end of the culverts to provide a temporary work area.

The upstream shoulder of breach N1 and the downstream shoulder of breach S3 have slightly different erosion control measures than the other breach shoulders. Breaches N1 and S3 are located at the sites where the new setback levee alignment deviates from the old, decommissioned levee alignment. Rock armoring will be placed on the slope of the waterside of the setback levee and will transition along the remnant levee segment.

On the waterside of the breaches, new riprap will be placed from the toe of the bank slope up to an elevation of +7 feet NAVD 88 in areas where the existing riprap is lacking. Breaches N1, N2, S1, and S2 also will have rock placed along portions of the base of the bank to further protect it from erosive forces. Coir fabric will be placed between elevations of +7 feet NAVD 88 and +10 feet NAVD 88, and will be planted with species suitable to create a vegetated bench. Coir fabric also will be placed in the zone between the edge of the +10 feet NAVD 88 elevation and the centerline of the breach, with jute netting continuing landward of the termination of the coir fabric for 100 feet. This area also will be planted with cuttings, rootstock, or container plants.

Rock will be placed onto the levee slope from atop the degraded levee, from the breach sill, from the waterside by means of barges, or by a combination of the three methods. Rock required within the channel, both below and slightly above the surface of the water at the time of placement, will be placed by a crane located on a barge and then spread by an excavator located on top of the levee or in the breach sill. Construction requires two barges—one barge to carry the crane and another to hold the stockpile of rock to be placed on the channel slopes—and one excavator located in the breach. Rock required on the upper portions of the slopes will be placed by an excavator located on top of the levee. Rock placement from atop the levee requires one excavator for each potential placement site. Loaders will haul rock from a permitted source within 25 miles of the project area and dump it within 100 feet of the levee breach. An excavator will move the rock from the stockpile to the waterside of the levee.

Southport Project Offset Floodplain Area Restoration

The offset floodplain area refers to the two expanded floodways located between the proposed setback levee and the decommissioned, remnant levee that will be created when portions of the

existing levee are breached (Appendix A). Project activities in this area will include floodplain and riparian habitat restoration and borrow excavation. The offset floodplain areas will be planted to provide mitigation for vegetation removed as part of construction.

If suitable for reuse, excavated material will be used in construction of the setback levee and seepage berms. Following excavation, the offset area will be graded to allow the creation and restoration of riverine floodplain and riparian habitats. Excavation in the offset areas may require groundwater management, done by pumping water out of excavated areas.

After the first two levee breaches are constructed and before the final three breaches are made, restoration plantings will be established in the offset floodplain areas during the fall, winter, and spring. Swales will be constructed in both offset floodplain areas, and the surrounding areas will be graded to create drainage to the swales as river stages decrease. Temporary and permanent erosion control measures such as jute netting, coconut fiber with net, live brush mattresses, and native turf will be used as appropriate to protect graded areas.

After breaches N2, S1, and S3 are constructed, three permanent cellular berms will be built across the offset area, between the setback levee and the remnant levee. The berms will be downstream of breaches N1, S1, and S2, and will create separate cells that will have independent drainage once water levels drop below the crest of the cellular berms. Material excavated from the breaches will be used to construct the cellular berms and construct terrain features. Berms will have a top elevation of +20 feet, top width of 20 feet, and side slopes no steeper than 10H:1V; they will overtop once water levels reach +20.0 feet NAVD 88. Floodplain upstream and downstream of the berms will be graded to drain away from the berms and to the closest existing levee breach location. Elevations in the offset floodplain area will vary from about +7.0 feet NAVD 88 to +20.0 feet NAVD 88 in order to provide broad habitat variability for a range of environmental and hydrodynamic conditions.

Habitats in the offset floodplain areas will be upland grasslands, riparian forest, shaded riverine aquatic habitat, and seasonal wetlands. Plants selected for establishment of each of the target plant communities were based on how the plants associate in nature, and the elevations at which these plants were observed growing along the Southport levee. A vegetation stratification survey on the Southport levee conducted by ICF in March of 2012 helped further inform and refine the restoration target plant communities. In the survey, different species of plants were observed to favor different elevation ranges based on species preferences and adaptations. The restoration design intends to mimic this vegetative stratification. Vegetation communities will include emergent marsh, riparian willow scrub, riparian cottonwood forest, mixed riparian woodland, elderberry shrubs and associated native plants for valley elderberry longhorn beetle habitat, and grassland. Planting of the offset area will take place in the fall following finish-grading operations and construction of the flood control features. Features of the offset area that are not finished in any given year will be kept free of vegetation to keep future construction areas clear.

Both container plants and pole cuttings may be used and will be spaced at regular intervals throughout the offset floodplain areas. Both overstory and understory species will be installed to mimic the natural structure of riparian forests along the Sacramento River. Supplemental irrigation will be provided for several years during the 3-year plant establishment period and then discontinued; irrigation water could possibly be pumped from the river or from an adjacent water supply by agreement with the owner. To avoid trampling or disturbing the plantings during the

establishment period, signs will be posted at appropriate intervals providing notice that access to the restoration areas is not allowed.

A network of seasonal wetland swales will be excavated within the offset floodplain area cells and will inundate during high-water events on the Sacramento River to provide habitat for special-status native fish species. The swales will be constructed to elevations that provide shallow, low-velocity, off-channel habitat in the spring during high-water periods. Floodplain inundation is expected to occur at the 1-year recurrence interval event at depths between 0.5 and 3 feet, and at the 2-year recurrence interval event at depths ranging from 9 to 12 feet. Swale margins will be gently sloping to maximize edge habitat during flood events. Instream woody material structures will be installed in some of the swales to provide cover from predators. In larger flood events during the winter and spring, the upper riparian terraces will be inundated and provide additional areas of habitat for fish as well as contribute to the productivity of the river ecology.

The created swales will have several connections to the main river channel at the breach locations in order to maximize connectivity and minimize potential stranding as floodwaters recede. The swales will fully dewater by early summer in a given year, on average, to discourage use by nonnative fish. Areas of upland grassland in the offset floodplain area will serve as potential floodplain rearing habitat for native fish during periods of high flows, as well as foraging habitat for raptors during periods of low water.

O&M access to the offset areas will be provided by O&M corridors at the waterside toe of the setback levee and by unpaved O&M roads that cross the cellular berms. At a minimum, turnaround areas will be located at the breach shoulders.

Southport Project Offset Area and Remnant Levee Revegetation
Revegetation of the offset areas and remnant levee is proposed as a means to mitigate for construction effects. The riparian willow scrub target plant community will be established in zones with proper soil hydrology, between +8 feet and +10 feet NAVD 88. In the offset area, riparian willow scrub will be established just upslope from the constructed swales in a band width varying from about 10 to 150 feet. On the remnant levee, riparian willow scrub will be established in a narrow band varying from about 5 to 20 feet in width outside of the canopy of the existing trees that will remain. The plants selected for the riparian willow scrub planting are intended to establish a self-sustaining mix of riparian scrub dominated by four species of willows. The plant material installed could be container grown plants, cuttings, or a mixture of both. The areas within the offset area will be seeded, and the areas on the remnant levee with established herbaceous cover will not be seeded.

Southport Project Road Construction, Marina Access, and Bees Lakes
Village Parkway will be extended southward from its current intersection with Lake Washington Boulevard to Gregory Avenue near the project area's southern extent, moving South River Road traffic to the landside of the Sacramento River South Levee and to the future Village Parkway alignment. The existing alignment of South River Road in Segment A will be retained, as will the railroad abutments at the southern end of Segment A. However, a detour or permanent realignment of South River Road will be constructed at the south end of Segment A to maintain access on South River Road south of the project area during and after construction. Access roads will be built in Segment B to connect residences to the new Village Parkway alignment. At the project's northern extent, South River Road will be demolished. Where practicable, culverts will be constructed in

ditches that are crossed by proposed roadways. Drainage ditches will be constructed along both sides of the new Village Parkway alignment, with an average width of 5 feet.

To maintain access between Sherwood Harbor Marina and Sacramento Yacht Club, South River Road will continue in its current alignment on the existing levee at Segment E and a portion of Segment F. However, to maintain access to the marinas, two new roads will be routed over the levee crown, across the offset area, and the across the decommissioned levee. The two access roads will be constructed to the north and south of the Bees Lake area. While the embankments will not be part of the flood risk–reduction features, they will prevent hydraulic surface connectivity between Bees Lakes and the Sacramento River. Linden and Davis Roads will be connected to the new Village Parkway alignment to restore traffic circulation, and a cul-de-sac will be added at the end of Linden Road, past the intersection with Village Parkway.

Dual access ramps will be constructed along the levee alignment to provide O&M and emergency access to the levee-top patrol road. One ramp will be in Segment B where South River Road currently descends from the existing levee to meet Gregory Avenue; one ramp in Segment C; one ramp in Segment D at the terminus of Davis Road; one ramp In Segment F at the terminus of Linden Road; and one ramp in Segment G near the northern end of the project alignment. Access to the levee-top patrol road also will be provided where the Sherwood Harbor Marina and Sacramento Yacht Club access road embankments cross the proposed setback levee crown. Access ramps will be gated and will have "no parking" signs.

Southport Project Construction Schedule

Construction of the Southport Project will occur in more than one annual construction season, with construction of flood risk–reduction measures beginning in April of 2015, and finishing in 2017. Construction and restoration of the offset floodplain area will continue after 2017, with final remnant levee breaches constructed in 2020. Some of the Village Parkway construction and utility relocations may occur earlier, but most of the work for those portions of the project will be done in 2015. A description of construction activities and tentative construction year is provided below.

2015:

- Village Parkway construction and utility relocation will be completed.
- Construction of the entire length of the new setback levee will begin with the foundation and working platform. Construction of the cutoff wall will follow if weather allows.

2016:

- The setback levee cutoff wall and remaining buildup of the setback levee will be constructed to a finished elevation of +40 feet NAVD 88.
- South River Road will be detoured at south end of Segment A.
- Seepage berms will be constructed following completion of the setback levee segments.
- Segment A and the southern portion of Segment B will be degraded to an elevation of +32 feet NAVD 88, and in Segment G the levee will be degraded to an elevation of +34.5 feet NAVD 88. Cutoff walls will then be constructed in these segments, tying into the setback levee cutoff walls in Segments B and F. The levee crown in Segment A and the southern portion of Segment B will then be built back up to a finished elevation of +39 feet NAVD 88, and the levee in Segment G will be built back up to a finished elevation of +40 feet NAVD 88. The slurry cutoff wall toe will be at an elevation of -5 feet NAVD 88 through

Segments A, B, C, and D; at 0 feet NAVD 88 for Segments E, F, and the southern portion of G; and will be at -67 feet NAVD 88 for the remainder of Segment G.

- The remnant levee in Segments B, C, D, and F will be degraded to an elevation of +30 feet NAVD 88, and will have a 20-foot-wide crown. Remnant levee degrading will be concurrent with setback levee and seepage berm construction.
- Offset floodplain area grading will begin.
- Erosion site repairs at C1, C2, and G3 will be constructed.

2017:

- Offset area grading will be completed. Culverts will be installed through the remnant levee at breaches N2, S1, and S2 to allow Sacramento River water flow into the offset floodplain areas.
- Breaches N1 and S3 will be constructed.
- Offset area planting will begin.

2018:

- Offset area planting will continue.

2019:

- The three remaining breaches and the offset area cellular berms will be constructed, and the southern offset area will be contoured.

2020:

- Offset area planting will be completed.

At the end of each construction season, the levee system will be restored, at a minimum, to the level of flood risk–reduction performance existing at the project outset. During construction Years 1 and 2, "tie-ins" will be built connecting the existing levee to newly constructed segments, as needed. These tie-ins will be achieved by benching the existing levee and installing compacted lifts to completely bond the new and existing levee materials. During the flood season, maintenance of the flood risk–reduction structures will be undertaken by the maintaining agency, RD 900.

Southport Project Sources of Borrow Material

To meet borrow material demands for constructing the flood risk–reduction measures, multiple sources may be used, including the following.

- Embankment fill material excavated from the existing levee structure as part of construction.
- Material excavated from the offset areas.
- Material excavated from borrow sites located on open land within the city, or close to the city limits.
- Dredged material previously removed from the Sacramento River Deep Water Ship Channel (presently stockpiled on high-terrace, upland benches adjacent to the west of the channel).
- Material purchased from permitted commercial borrow locations within 20 miles of the project site (as described on pages 7-8).

Southport Project Vegetation Removal
Vegetation clearing activities entail removing larger woody vegetation, such as trees and shrubs. Grubbing activities consist of removing roots, and stripping activities requires excavating about 6 inches of organic material from the levee surface. Vegetation on the decommissioned levee segments along the Sacramento River levee will be retained where feasible, with the exception of the five breach locations. However, some vegetation will be removed as part of construction of the new setback levee, seepage berms, and the landside utility O&M corridor.

Southport Project Staging Areas and Equipment Access
Five staging areas are designated for the Southport Project. The staging areas are located on the landside of the levee at Segments C, D, and E, and occupy about 25.2 acres in total (Appendix A). Areas where seepage berms are proposed also may be used for staging until construction begins on the seepage berms. To facilitate project construction, temporary earthen ramps will be constructed to permit equipment access between the levee crown and each staging area. The earthen ramps will not affect any delineated water bodies and will be removed when construction is complete.

Southport Project Operations and Maintenance
Following construction of the Southport Project, only the rock slope protection, native vegetation, and other biotechnical features will be permanent. Anticipated O&M actions include regular visual inspections of the site, vegetation maintenance and irrigation for up to 3 years, and periodic repairs, as needed, to prevent or repair localized scour along the bank and rock toe of the site. The previously mentioned O&M activities that pertain to the project as a whole will also occur along Sacramento River South levee reach following the Southport Project construction.

Conservation Measures

As part of the West Sacramento GRR Project description, the Corps and WSAFCA have committed to implementing the following conservation measures to avoid and minimize potential effects on the snake, beetle, smelt, and smelt critical habitat. A number of measures will be applied to the entire project or specific actions, and other measures may be appropriate at specific locations within the study area. Avoidance activities to be implemented during final design and construction include, but are not limited to:

- Avoiding vegetation removal to the extent feasible.
- Avoiding, to the extent possible, grubbing and contouring activities.
- Identifying all habitats containing, or with a substantial possibility of containing, listed terrestrial, wetland, and plant species in the potentially affected project areas. To the extent practicable, efforts will be made to minimize effects by modifying engineering design to avoid potential direct and indirect effects.
- Incorporating sensitive habitat information within project bid specifications.
- Incorporating requirements for contractors to avoid identified sensitive habitats within project bid specifications.

<u>General Conservation Measures</u>

- The Corps will seek a variance exempting the Sacramento River levee reaches from vegetation removal as per ETL 1110-2-583 in the lower one-third of the waterside of the levee prior to final construction and design phase. Construction will require removal of vegetation on the upper two-thirds of the waterside and landside slope. Full ETL vegetation

compliance will occur on the Sacramento and Yolo Bypasses, Yolo Bypass Toe Drain, South Cross Toe Drain, and the Sacramento River Deep Water Ship Channel, Barge Canal, and Port of West Sacramento levee reaches.

- The Corps will use a rock soil mixture (a 70:30 rock to soil ratio) to facilitate re-vegetation of the Sacramento River project sites that require bank protection work. The soil-rock mixture will be placed on top of the of the rock revetment along the Sacramento River levees to allow native riparian vegetation to be planted and ensure that shaded riverine aquatic habitat is replaced or enhanced.
- In addition to an approved vegetation variance, the Corps will avoid the removal of existing vegetation in the proposed project area. To the extent possible, disturbance or removal of trees or larger woody vegetation will be replaced onsite with native riparian species, except in the vegetation-free zone, as established in ETL 1110-2-583.
- Best management practices will be implemented to prevent slurry seeping out to the river and require a piping system on the landside.
- Construction materials such as portable equipment, vehicles, and supplies, will be stored at designated construction staging areas and barges, exclusive of any riparian and wetlands areas.
- All liquid chemicals and supplies will be stored at a designated impermeable membrane fuel and refueling station.
- Erosion control measures, including a Storm Water Pollution Prevention Program and a Water Pollution Control Program, will be implemented to minimize soil or sediment from entering the river. The measures shall be installed, monitored for effectiveness, and maintained throughout construction operations to minimize any effects to federally-listed fish and their designated critical habitat.
- Construction will be scheduled when listed terrestrial and aquatic species will be least likely to occur in the project area.
- Site access will be limited to the smallest area possible in order to minimize disturbance.
- Litter, debris, and unused materials will be removed from the project area daily. Such materials or waste will be deposited at an appropriate disposal or storage site.
- Any spills of hazardous materials will be cleaned up within 24 hours and reported to the resource agencies. Any such spills, and the success of the efforts to clean them up, shall also be reported in post-construction compliance reports.
- A Corps-appointed biologist will serve as the point-of-contact for any contractor who might incidentally take a living, or find a dead, injured, or entrapped threatened or endangered species. The representative shall be identified to the employees and contractors during an all employee education program conducted by the Corps.
- Screen any water pump intakes, as specified by NMFS and Service screening specifications. Water pumps will maintain an approach velocity of 0.2 feet per second or less when working in areas that may support delta smelt.

Giant Garter Snake Conservation Measures

The following measures will be implemented to minimize effects on giant garter snake habitat that occurs within 200 feet of any construction activity. These measures are based on Service guidelines for restoration and standard avoidance measures (Service 1997).

- Construction will be initiated only during the snake's active period of May 1–October 1, when they are able to move away from disturbance.
- Construction personnel will participate in a Service-approved worker environmental awareness program.
- A snake survey will be conducted 24 hours prior to construction in potential habitat. Should there be any interruption in work for greater than 2 weeks, a biologist will survey the project area again no later than 24 hours prior to the restart of work.
- Snakes encountered during construction activities will be allowed to move away from construction activities on their own.
- Movement of heavy equipment to and from the construction site will be restricted to established roadways. Stockpiling of construction materials will be restricted to designated staging areas, which will be located more than 200 feet away from snake aquatic habitat.
- Snake habitat within 200 feet of construction activities will be designated as an environmentally sensitive area and delineated with signs or fencing. This area will be avoided by all construction personnel.
- For projects that anticipate that work may be required past the end of the giant garter snake active season (October 1) and into their inactive season, additional measures must be implemented by the applicant. All of the following minimization measures must be implemented in order for work to continue past the October 1 deadline:
    - The Corps shall contact the Service on or before August 15, to determine if any additional measures are needed to minimize effects to the snake.
    - Work activities must commence on or before September 15.
    - A service-approved biologist will be on-site daily to monitor all construction activities associated with the project throughout the entire extension period.
    - Snake exclusion fencing must be completely installed prior to the October 1 deadline. Snake exclusion fencing will be used to enclose the entire work area preventing the snake from entering the work area. The exclusion fencing will remain in place and in good working order until project activities are completed.

If any giant garter snake habitat is affected by construction, the following measures will be implemented to compensate for the habitat loss:

- Aquatic and upland habitat temporarily affected for one season (May 1–October 1) will be restored after construction by applying appropriate erosion control techniques and replanting/seeding with appropriate native plants.
- Habitat temporarily affected for two seasons will be restored and replacement habitat will be created at a 2:1 ratio of created to disturbed acres.
- Habitat temporarily affected for more than two seasons will be replaced at a 2:1 ratio, or restored plus 2:1 replacement.
- Habitat permanently affected will be replaced at a 3:1 ratio. Habitat permanently or temporarily affected outside of the May 1-October 1 work window will be created at a 2:1 ratio.
- All replacement habitats will include both upland and aquatic habitat components at a 2:1 ratio of upland to aquatic acres.
- One year of monitoring will be conducted for all restored areas. Ten years of monitoring will be conducted for created habitats. A monitoring report with photo documentation will

be due to Service each year following implementation of restoration or habitat creation activities.

- The Corps will work to develop appropriate mitigation prior to or concurrent with any disturbance of giant garter snake habitat.
- Habitat will be protected in perpetuity and have an endowment attached for management and maintenance.

Valley Elderberry Longhorn Beetle Conservation Measures

The following is a summary of measures based on the Conservation Guidelines for the Valley Elderberry Longhorn Beetle (Conservation Guidelines) (Service 1999a). These measures will be implemented to minimize any potential effects on the beetle, the sole host plant for the beetle, including restoration and maintenance activities, long-term, protection, and compensation if elderberry shrubs cannot be avoided. Based on worst-case scenario estimates of project effects and surveys between 2011 and 2013, a total of 120 elderberry shrubs may be adversely affected by construction of the West Sacramento GRR Project.

- When a 100-foot or wider buffer is established and maintained around elderberry shrubs, complete avoidance will be assumed. Where encroachment on the 100-foot buffer will occur, a setback of 20 feet from the dripline of each elderberry shrub will be maintained whenever possible.
- During construction activities, all areas to be avoided will be fenced and flagged.
- Contractors will be briefed on the need to avoid damaging elderberry shrubs and the possible penalties for not complying with these requirements.
- Signs will be erected every 50 feet along the edge of the avoidance area containing information about the beetle and its habitat.
- Any damage done to the buffer area will be restored.
- During construction activities, no insecticides, herbicides, fertilizers, or other chemicals that might harm the beetle or its host plant will be used in the buffer areas.
- Elderberry shrubs that cannot be avoided and can be accessed safely will be transplanted to an appropriate off-site riparian area at least 100 feet from construction activities.
- Elderberry shrubs will be transplanted during their dormant season, which occurs from November, after they have lost their leaves, through the first two weeks in February. If transplantation occurs during the growing season, increased mitigation ratios will apply.
- Any areas that receive transplanted elderberry shrubs, as well as elderberry and associated native species plantings, will be protected in perpetuity.
- The Corps will work to develop off-site compensation areas prior to or concurrent with any take of valley elderberry longhorn beetle habitat.
- Management of these lands will include all measures specified in the Conservation Guidelines related to weed and litter control, fencing, and the placement of signs.
- Monitoring will occur for 10 consecutive years or for 7 non-consecutive years over a 15-year period. Annual monitoring reports will be submitted to the Service.
- Off-site compensation areas will be protected in perpetuity and have a funding source for maintenance (an endowment).

Conservation Measures for the Southport Project

Because the Southport Project along the Sacramento River South levee is scheduled as an Early Implementation Project it will be the first construction project under the West Sacramento GRR Project, and therefore conservation measures have been established in greater detail. The Corps and WSAFCA have committed to implementing the following conservation measures as part of the Southport Project.

Southport Project General Conservation Measures

Conduct mandatory biological awareness training for all project personnel and implement general requirements:

Before any ground-disturbing work (including vegetation clearing and grading) occurs in the Southport Project action area, a Service-approved biologist will conduct a mandatory biological resources awareness training for all construction personnel about Federally listed species that could potentially occur onsite. The training will include the natural history, representative photographs, and legal status of each Federally listed species and avoidance and minimization measures to be implemented. Proof of personnel attendance will be provided to the Service within 1 week of the training. If new construction personnel are added to the Southport Project, the contractor will ensure that the new personnel receive the mandatory training before starting work. The subsequent training of personnel can include videotape of the initial training and/or the use of written materials rather than in-person training by a biologist. Elements of the training that will be followed by construction personnel are listed below:

- Where suitable habitat is present for listed species, WSAFCA will clearly delineate the construction limits through the use of survey tape, pin flags, orange barrier fencing, or other means, and prohibit any construction-related traffic outside these boundaries.
- Project-related vehicles will observe the posted speed limit on hard-surfaced roads and a 10-mile-per-hour speed limit on unpaved roads during travel in the project construction area.
- Project-related vehicles and construction equipment will restrict off-road travel to the designated construction areas.
- All food-related trash will be disposed of in closed containers and removed from the project construction area at least once per week during the construction period. Construction personnel will not feed or otherwise attract fish or wildlife to the project area.
- No pets or firearms will be allowed in the project area.
- To prevent possible resource damage from hazardous materials, such as motor oil or gasoline, construction personnel will not service vehicles or construction equipment outside designated staging areas.
- Any worker who inadvertently injures or kills a federally-listed species or finds one dead, injured, or entrapped will immediately report the incident to the biological monitor and construction foreman. The construction foreman will immediately notify WSAFCA, who will provide verbal notification to the Service within 1 working day. WSAFCA will follow up with written notification to the Service within 5 working days. The biological monitor will follow up with WSAFCA to ensure that the wildlife agencies were notified.

Prepare and implement a Stormwater Pollution Prevention Plan

Because ground disturbance would be greater than 1 acre, WSAFCA will obtain coverage under the U.S. Environmental Protection Agency's (EPA's) National Pollutant Discharge Elimination System (NPDES) general construction activity stormwater permit. The Central Valley Regional Water Quality Control Board administers the NPDES stormwater permit program in Yolo County.

Obtaining coverage under the NPDES general construction activity permit generally requires that the project applicant prepare a stormwater pollution prevention plan that describes the Best Management Practices that will be implemented to control accelerated erosion, sedimentation, and other pollutants during and after project construction. The SWPPP will be prepared prior to commencing earth-moving construction activities.

The plan likely will include, but not be limited to, one or more of the following standard erosion and sediment control practices:

- The construction contractor will conduct all construction activities during the typical construction season to avoid ground disturbance during the rainy season. To the extent possible, equipment and materials will be staged in areas that have already been disturbed. No equipment or materials would be stored in the floodway during the flood season.
- The construction contractor will minimize ground disturbance and the disturbance/destruction of existing vegetation. This will be accomplished in part through the establishment of designated equipment staging areas, ingress and egress corridors, and equipment exclusion zones prior to the commencement of any grading operations.
- Grading spoils generated during the construction will be temporarily stockpiled in staging areas. Silt fences, fiber rolls, or similar devices will be installed around the base of the temporary stockpiles to intercept runoff and sediment during storm events. If necessary, temporary stockpiles may be covered with an appropriate geotextile to increase protection from wind and water erosion.
- The construction contractor may install silt fences, fiber rolls, or similar devices to prevent sediment-laden runoff from leaving the construction area.
- The construction contractor may install silt fences, drop inlet sediment traps, sandbag barriers, and/or other similar devices.
- The construction contractor will install structural and vegetative methods to permanently stabilize all graded or otherwise disturbed areas once construction is complete. Structural methods may include the installation of biodegradable fiber rolls and erosion control blankets. Vegetative methods may involve the application of organic mulch and tackifier and/or the application of an erosion control native seed mix.

Prepare and Implement a Bentonite Slurry Spill Contingency Plan (Frac-Out Plan)

Before excavation begins, WSAFCA will ensure the contractor will prepare and implement a bentonite slurry spill contingency plan (BSSCP) for any excavation activities that use pressurized fluids (other than water). If the contractor prepares the plan, it will be subject to approval by the Corps, NMFS, and WSAFCA before excavation can begin. The BSSCP will include measures intended to minimize the potential for a frac-out ("fracture-out event") associated with excavation and tunneling activities; provide for the timely detection of frac-outs; and ensure an organized, timely, and minimum-effect response in the event of a frac-out and release of excavation fluid (bentonite). The BSSCP will require, at a minimum, the following measures:

- If a frac-out is identified, all work will stop, including the recycling of the bentonite fluid. In the event of a frac-out into water, the location and extent of the frac-out will be determined, and the frac-out will be monitored for 4 hours to determine whether the fluid congeals (bentonite will usually harden, effectively sealing the frac-out location).
- NMFS, CDFW, and the Central Valley Regional Water Quality Control Board will be notified immediately of any spills and will be consulted regarding clean-up procedures. A

Brady barrel will be on site and used if a frac-out occurs. Containment materials, such as straw bales, also will be on site prior to and during all operations, and a vacuum truck will be on retainer and available to be operational on site within a 2-hour notice. The site supervisor will take any necessary follow-up response actions in coordination with agency representatives. The site supervisor will coordinate the mobilization of equipment stored at staging areas (e.g., vacuum trucks), as needed.

- If the frac-out has reached the surface, any material contaminated with bentonite will be removed by hand to a depth of 1 foot, contained, and properly disposed of, as required by law. The drilling contractor will be responsible for ensuring that the bentonite is either properly disposed of at an approved Class II disposal facility or properly recycled in an approved manner.
- If the bentonite fluid congeals, no other actions, such as disturbance of the streambed, will be taken that potentially would suspend sediments in the water column.
- The site supervisor has overall responsibility for implementing this BSSCP. The site supervisor will be notified immediately when a frac-out is detected. The site supervisor will be responsible for ensuring that the biological monitor is aware of the frac-out; coordinating personnel, response, cleanup, and regulatory agency notification and coordination to ensure proper clean-up; coordinating disposal of recovered material; and timely reporting of the incident. The site supervisor will ensure all waste materials are properly containerized, labeled, and removed from the site to an approved Class II disposal facility by personnel experienced in the removal, transport, and disposal of drilling mud.
- The site supervisor will be familiar with the contents of this BSSCP and the conditions of approval under which the activity is permitted to take place. The site supervisor will have the authority to stop work and commit the resources necessary to implement this plan. The site supervisor will ensure that a copy of this plan is available onsite and accessible to all construction personnel. The site supervisor will ensure that all workers are properly trained and familiar with the necessary procedures for response to a frac-out prior to the commencement of excavation operations.

Prepare and Implement a Spill Prevention, Control, and Counter-Measure Plan

A spill prevention, control, and counter-measure plan (SPCCP) is intended to prevent any discharge of oil into navigable water or adjoining shorelines. WSAFCA or its contractor will develop and implement an SPCCP to minimize the potential for and effects from spills of hazardous, toxic, or petroleum substances during construction and operation activities. The SPCCP will be completed before any construction activities begin. Implementation of this measure will comply with state and Federal water quality regulations. The SPCCP will describe spill sources and spill pathways in addition to the actions that will be taken in the event of a spill (e.g., an oil spill from engine refueling will be immediately cleaned up with oil absorbents). The SPCCP will outline descriptions of containments facilities and practices such as double-walled tanks, containment berms, emergency shutoffs, drip pans, fueling procedures, and spill response kits. It will describe how and when employees are trained in proper handling procedure and spill prevention and response procedures. WSAFCA will review and approve the SPCCP before onset of construction activities and routinely inspect the construction area to verify that the measures specified in the SPCCP are properly implemented and maintained. WSAFCA will notify its contractors immediately if there is a noncompliance issue and will require compliance. If a spill is reportable by regulation, the contractor's superintendent will notify WSAFCA, and WSAFCA will take action to contact the appropriate safety and cleanup crews to ensure that the SPCCP is followed. If an appreciable spill

occurs and results determine that project activities have adversely affected surface or groundwater quality, a detailed analysis will be performed by a registered environmental assessor or professional engineer to identify the likely cause of contamination. This analysis will conform to American Society for Testing and Materials standards and will include recommendations for reducing or eliminating the source or mechanisms of contamination. Based on this analysis, WSAFCA and its contractors will select and implement measures to control contamination, with a performance standard that surface water quality and groundwater quality must be returned to baseline conditions.

Monitor Turbidity in Adjacent Water Bodies

WSAFCA or its contractor will monitor turbidity in the adjacent water bodies, where applicable criteria apply, to determine whether turbidity is being affected by construction and ensure that construction does not affect turbidity levels, which ultimately increase the sediment loads. The Water Quality Control Plan for the Central Valley Regional Water Quality Control Board (Basin Plan) contains turbidity objectives for the Sacramento River. WSAFCA or its contractor will monitor ambient turbidity conditions upstream during construction and adhere to the Surface Water Quality Ambient Monitoring Program requirements for turbidity monitoring. Monitoring will continue approximately 300 feet downstream of construction activities to determine whether turbidity is being affected by construction. Grab samples will be collected at a downstream location that is representative of the flow near the construction site. If there is a visible sediment plume being created from construction, the sample will represent this plume. Monitoring will occur hourly when construction encroaches into the Sacramento River. If construction does not encroach into the river, the monitoring will occur once a week on a random basis. If turbidity limits exceed Basin Plan standards, construction-related earth-disturbing activities will slow to a point that results in alleviating the problem. WSAFCA will notify the Central Valley Regional Water Quality Control Board of the issue and provide an explanation of the cause.

Prepare and implement a Mitigation and Monitoring Plan (MMP)

A draft MMP for the restoration areas is being developed and will be approved by the Corps, NMFS, Service, and CDFW before implementation of the Southport Project. The restoration objectives of the plan are listed below:

- Provide compensatory mitigation credits for effects on protected land cover-types and to special-status species and potential habitat for these species.
- Maximize shaded riverine aquatic cover/nearshore habitat, over and above current erosion stabilization efforts using biotechnical methods.
- Enhance setback ecological values using topographic and vegetation/habitat heterogeneity.
- Restore portions of the historic Sacramento River floodplain (i.e., waters of the United States).
- Restore riparian and oak woodland habitat on the restored floodplain that will create continuous habitat corridors for fish and wildlife movement.
- Design habitat features to minimize future maintenance obligations (e.g., reduce opportunities for sediment and debris accumulation).
- Design floodplain planting and vegetation management schemes to avoid undesirable hydraulic and sediment transport effects to the offset levee and offset area.
- Comply with current Corps levee vegetation policy to balance habitat needs with flood management objectives.

The monitoring objectives of the MMP are listed below:

- Monitor and evaluate the hydrologic and hydraulic performance of the restored floodplain relative to the ecological design criteria for the target species.
- Monitor and evaluate the success of the riparian/floodplain plantings and other habitat features in compensating, restoring, or enhancing fish and wildlife habitat values on the levee slopes and offset areas.
- Monitor and evaluate the effectiveness of the grading and drainage features in preventing fish stranding.
- Monitor the occurrence and extent of potential sedimentation and scour that may compromise the success of the habitat restoration and mitigation components of the project.

Giant Garter Snake Conservation Measures for the Southport Project

Conservation measures for giant garter snake were developed using portions of the Programmatic Formal Consultation for U.S. Army Corps of Engineers 404 Permitted Projects with Relatively Small Effects on the Giant Garter Snake within Butte, Colusa, Glenn, Fresno, Merced, Sacramento, San Joaquin, Solano, Stanislaus, Sutter, and Yolo Counties, California (Service 1997).

Conduct all construction activities during the active period for the giant garter snake: To the maximum extent possible, all construction activity within giant garter snake aquatic and upland habitat within 200 feet of aquatic habitat will be conducted during the snake's active period (May 1–October 1). During this time frame, potential for injury and mortality are lessened because snakes are actively moving and avoiding danger. Construction of the setback levee in Segment B through Segment F will begin in 2015. The setback levee and the remaining flood risk – reduction measures for all segments would be completed in 2016. Some preparation of construction may occur during the 2014 construction season, but no changes will be made to the existing levee prism. The construction season is typically from April 15 to October 31, subject to weather and other conditions. Because some construction may extend into the giant garter snakes dormant period (October 2 to April 30), additional protective measures will be implemented at these locations.

Install and maintain construction barrier fencing around suitable giant garter snake habitat: To reduce the likelihood of snakes entering the construction area, exclusion fencing and orange barrier fencing will be installed along the portions of the construction area that are within 200 feet of suitable aquatic and upland habitat. The exclusion and barrier fencing will be installed during the active period for giant garter snakes to reduce the potential for injury and mortality during this activity.

The construction specifications will require a provision to retain a qualified biologist to identify the areas that are to be avoided during construction. Areas adjacent to the directly affected area required for construction, including staging and access, will be fenced off to avoid disturbance in these areas. Before construction, the contractor will work with the qualified biologist to identify the locations for the barrier fencing and will place flags or flagging around the areas to be protected to indicate the locations of the barrier fences. The protected area will be clearly identified on the construction specifications. The fencing will be installed the maximum distance practicable from the aquatic habitat areas and will be in place before construction activities are initiated.

The barrier fencing will consist of 4-foot-tall erosion fencing buried at least 6–8 inches below ground level. The barrier fencing will ensure that giant garter snakes are excluded from the

construction area and that suitable upland and aquatic habitat is protected throughout construction. The exclusion fencing will be commercial-quality, tightly-woven polypropylene fabric, orange in color, and 4 feet high (Tensor Polygrid or equivalent). The fencing will be tightly strung on posts with a maximum of 10-foot spacing.

Barrier and exclusion fences will be inspected daily by a qualified biological monitor during ground-disturbing activities. Once all initial ground-disturbing activities are completed, the biological monitor will perform weekly checks of the site for the duration of construction in order to ensure that construction barrier fences and exclusion fences are in good order, trenches are being covered, project personnel are conducting checks beneath parked vehicles prior to their movement, and that all other required biological protection measures are being complied with. The biological monitor will document the results of monitoring on construction monitoring log sheets, which will be provided to the Service within 1 week of each monitoring visit. Monitoring will continue until project construction is complete or until the fences are removed, as approved by the biological monitor and the resident engineer. The biological monitor will be responsible for ensuring that the buffer area fences around giant garter snake habitat are maintained throughout construction. Biological inspection reports will be provided to the project lead and the Service.

Minimize potential effects on giant garter snake habitat: The following measures will be implemented to minimize potential effects on giant garter snake habitat:

- Staging areas will be located at least 200 feet from suitable snake habitat;
- Any dewatered habitat will remain dry for at least 15 consecutive days after April 15 and prior to excavating or filling of the dewatered habitat;
- Vegetation clearing within 200 feet of the banks of suitable snake aquatic habitat will be limited to the minimum area necessary. Avoided snake habitat within or adjacent to the action area will be flagged and designated as an environmentally sensitive area, to be avoided by all construction personnel;
- The movement of heavy equipment within 200 feet of the banks of suitable snake aquatic habitat will be confined to designated haul routes to minimize habitat disturbance; and
- Conduct preconstruction surveys and monitoring for the giant garter snake.

Prior to ground-disturbing activities within 200 feet of suitable habitat, a Service-approved biological monitor will conduct a preconstruction survey of suitable aquatic and upland habitat and inspect exclusion and orange barrier fencing to ensure they are both in good working order each morning. If any snakes are observed within the construction area at any other time during construction the biological monitor will be contacted to survey the site for giant garter snakes. The biological monitor will have the authority to stop construction activities until appropriate corrective measures have been completed or it is determined that the snake will not be harmed. Giant garter snakes encountered during construction activities will be allowed to move away from construction activities on their own. If they are unable to move away on their own, trapped or injured, giant garter snakes will only be removed by Service-permitted personnel and will be placed in the nearest suitable habitat that is outside of the construction area. The biological monitor will immediately report these activities to the Service by phone and will provide a written account of the details of the incident within 24 hours.

Provide escape ramps or cover open trenches at the end of each day: To avoid the entrapment of snakes, all excavated areas more than 1 foot deep will be provided with one or more escape ramps constructed of earth fill or wooden planks at the end of each workday. If escape ramps cannot be provided, then holes or trenches will be covered with plywood or other hard material. The biological monitor or construction personnel designated by the contractor will be responsible for thoroughly inspecting trenches for the presence of giant garter snakes at the beginning of each workday. If any snakes become trapped, the Service-approved biological monitor will be contacted to relocate the snake, and no work will occur in that area until approved by the biological monitor.

Implement additional protective measures during work in suitable habitat during the giant garter snake dormant period: The following additional protective measures will be implemented during time periods when work must occur during the giant garter snake dormant period (October 2–April 30), when snakes are more vulnerable to injury and mortality:

- A full-time Service-approved biological monitor will be onsite for the duration of construction activities;
- All emergent vegetation and vegetation within 200 feet of suitable aquatic habitat will be cleared prior to the giant garter snake hibernation period (i.e., vegetation clearing must be completed by October 1); and
- Exclusion and barrier fencing will be installed around the perimeter of the work area and across drainage areas where activities associated with levee slope flattening and pipe reconstruction activities will occur. The fencing will enclose the work area to the maximum extent possible to prevent snakes from entering the work area. Fencing will be installed during the active period for snakes (May 1–October 1) to reduce the potential for injury and mortality during fence installation. The Service-approved biological monitor will work with the contractor to determine where fencing should be placed and will monitor fence installation. The barrier fencing will consist of 3- to 4-foot-tall erosion fencing buried at least 6 to 8 inches below ground level. The barrier fencing will minimize opportunities for giant garter snake hibernation in the adjacent upland area.

Portions of the construction area that are temporarily disturbed during construction will be re-vegetated with emergent vegetation and adjacent disturbed upland habitat will be re-vegetated with native grasses and forbs after construction is complete.

Restore temporarily disturbed aquatic and upland habitat to pre-project conditions: Upon completion of the Southport Project, 155 acres of suitable upland habitat will be restored in the borrow areas for giant garter snake to pre-project conditions. There will be no temporary loss of aquatic habitat. All of the temporary habitat effects will occur in the borrow areas within West Sacramento. The actual temporary effects from borrow activities will be substantially less pending an analysis on the suitability of potential borrow materials.

Suitable upland habitat for giant garter snakes consists of fallow agricultural fields and nonnative annual grassland. Cultivated and disked agricultural fields were not considered suitable upland habitat for giant garter snake because they are frequently disturbed during farming activities. Temporarily affected upland habitat will be restored to pre-project conditions within a maximum of one season (a season is defined as the calendar year between May 1 and October 1 [Service 1997]).

Restoration of upland habitat will be detailed in a mitigation and monitoring plan that will be reviewed and approved by the Service prior to the start of construction.

Compensate for the direct loss of giant garter snake upland habitat: The permanent loss of 2.24 acres of upland habitat will be compensated for by restoring habitat onsite or by purchasing credits from a Service-approved mitigation bank. There will be no permanent loss of aquatic habitat.

Valley Elderberry Longhorn Beetle Conservation Measures for the Southport Project
Conservation measures for beetle for the Southport Project are based on the Service's Conservation Guidelines (Service 1999a).

Fence Elderberry Shrubs to be Protected and Monitor Fencing during Construction: Elderberry shrubs and clusters within 100 feet of the construction area that will not be removed will be protected during construction. A qualified biologist (i.e., with elderberry/beetle experience), under contract with WSAFCA, will mark the elderberry shrubs and clusters that will be protected during construction. Orange construction barrier fencing will be placed at the edge of the respective buffer areas. The buffer area distances will be proposed by the biologist and approved by Service. No construction activities will be permitted within the buffer zone other than those activities necessary to erect the fencing. Signs will be posted every 50 feet along the perimeter of the buffer area fencing. The signs will contain the following information:
"This area is habitat of the valley elderberry longhorn beetle, a threatened species, and must not be disturbed. This species is protected by the Endangered Species Act of 1973, as amended. Violators are subject to prosecution, fines, and imprisonment."

In some cases, where the elderberry shrub dripline is within 10 feet of the work area, k-rails will be placed at the shrub's dripline to provide additional protection to the shrub from construction equipment and activities. Temporary fences around the elderberry shrubs and k-rails at shrub driplines will be installed as the first order of work. Temporary fences will be furnished, constructed, maintained, and later removed, as shown on the plans, as specified in the special provisions, and as directed by the project engineer. Temporary fencing will be 4 feet high, commercial-quality woven polypropylene, and orange in color.

Buffer area fences around elderberry shrubs will be inspected weekly by a qualified biological monitor during ground-disturbing activities and monthly after ground-disturbing activities until project construction is complete or until the fences are removed, as approved by the biological monitor and the resident engineer. The biological monitor will be responsible for ensuring that the contractor maintains the buffer area fences around elderberry shrubs throughout construction. Biological inspection reports will be provided to the project lead and Service.

Conduct Stem Counts Prior to Elderberry Shrub Transplantation: Surveys of elderberry shrubs to be transplanted will be conducted by a qualified biologist prior to transplantation. The biologist will survey the area surrounding the shrub to be transplanted to ensure that there are not additional elderberry shrubs that need to be removed. Surveys will consist of counting and measuring the diameter of each stem at ground level and examining elderberry shrubs for the presence of beetle exit holes. Survey results and an analysis of the number of elderberry seedlings/cuttings and associated native plants based on the survey results will be submitted to Service. Elderberry seedlings/cuttings and associated native plants will be planted prior to transplantation of elderberry

shrubs. The data collected during the surveys prior to transplantation will be used to determine if compensation requirements or take limits are being exceeded, and if additional plantings are necessary. Because construction of the Southport project will occur over multiple years, elderberry survey data for each year will be used to rectify any discrepancies in compensation and to ensure full compensation of effects on the beetle. Surveys for the beetle are valid for a period of 2 years (Service 1999a).

Water the construction area to control dust: The construction contractor will ensure that the project construction area will be watered as necessary to prevent dirt from becoming airborne and accumulating on elderberry shrubs within the 100–foot buffer.

Compensate for direct effects on valley elderberry longhorn habitat: Before construction begins, compensation will be implemented for direct effects on elderberry shrubs by transplanting shrubs that cannot be avoided to a Service-approved conservation area. Elderberry seedlings or cuttings and associated native species will also be planted in the conservation area. Each elderberry stem measuring 1 inch or greater in diameter at ground level that is adversely affected will be replaced in the conservation area, with elderberry seedlings or cuttings at a ratio ranging from 1:1 to 8:1 (new plantings to affected stems). The numbers of elderberry seedlings/cuttings and associated riparian native trees/shrubs to be planted as replacement habitat are determined by stem size class of affected elderberry shrubs, presence or absence of exit holes, and whether the shrub lies in a riparian or non-riparian area. Stock of either seedlings or cuttings will be obtained from local, Service-approved sources. At the discretion of the Service, shrubs that are unlikely to survive transplantation because of poor condition or location, or a plant that will be extremely difficult to move because of access problems, may be exempted from transplantation. In cases in which transplantation is not possible, minimization ratios will be increased to offset the additional habitat loss.

The relocation of elderberry shrubs will be conducted according to Service-approved procedures outlined in the Conservation Guidelines (Service 1999a). Elderberry shrubs within the project construction area that cannot be avoided will be transplanted during the plant's dormant phase, which is November through the first 2 weeks of February. A qualified biological monitor will remain onsite while the shrubs are being transplanted.

Proposed Conservation Area

About 120 acres of riparian habitat in the Offset floodplain area will be restored or enhanced as part of the project implementation. Based on the Conservation Guidelines (Service 1999a), a total of 13.51 acres of the floodplain will be riparian habitat required for beetle compensation plantings for the Southport Project.

Evidence of the beetle occurrence in the conservation area, the condition of the elderberry shrubs in the conservation area, and the general condition of the conservation area itself will be monitored over a period of 10 consecutive years or for 7 years over a 15-year period from the date of transplanting. Monitoring reports will be provided to the Service in each of the years in which monitoring is required. As specified in the Conservation Guidelines, the report will include information on timing and rate of irrigation, growth rates, and survival rates and mortality.

To meet the success criteria specified in the Conservation Guidelines, a minimum survival rate of 60% of the original number of elderberry replacement plantings and associated native plants must be maintained throughout the monitoring period.

Action Area

The action areas is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." For the purposes of the effects assessment, the action area encompasses the Sacramento River from the Sacramento Bypass downstream to the South Cross Levee, the Sacramento Deep Water Ship Channel and the Port of West Sacramento, and the Sacramento and Yolo Bypasses (Figure 1).

The City of West Sacramento is bisected into two basins by the Sacramento River Deep Water Ship Channel and the Port of West Sacramento, and is contained within the levees of the West Sacramento GRR Project. The north basin encompasses 6,100 acres, while the south basin is 6,900 acres. Potential borrow areas, transportation routes, and staging areas have been identified within the city, as well as within 20 miles of West Sacramento. The potential borrow areas identified in Figure 2 are also part of the action area.

The action area also includes the perennial waters extending 200 feet perpendicular from shorelines adjacent to construction areas, and 1,000 feet downstream of the in-water construction areas. These distances represent the extent to which turbidity and sedimentation from the West Sacramento GRR Project may affect the waters.

Analytical Framework for the Jeopardy and Adverse Modifications Determinations

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this biological opinion relies on four components: (1) the Status of the Species, which evaluates snake, beetle, and smelt range-wide conditions, the factors responsible for these conditions, and the survival and recovery needs of each species; (2) the Environmental Baseline, which evaluates the condition of the snake, beetle, and smelt in the action area, the factors responsible for these conditions, and the relationship of the action area to the survival and recovery of each species; (3) the Effects of the Action, which determines the direct and indirect effects of the proposed Federal action and the effects of any interrelated or interdependent activities on the snake, beetle, and smelt; and (4) the Cumulative Effects, which evaluates the effects of future, non-Federal activities in the action area on the snake, beetle, and smelt.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the current status of the snake, beetle, and smelt, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of recovery of each species in the wild.

The jeopardy analysis in this biological opinion places an emphasis on consideration of the range-wide survival and recovery needs of the snake, beetle, smelt, as well as the role of the action area in the survival and recovery of each species as the context for evaluating the significance of the effects

of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination
This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.2. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this biological opinion relies on four components: (1) the Status of the Critical Habitat, which evaluates the range-wide condition of critical habitat for the smelt in terms of primary constituent elements (PCE)s, the factors responsible for that condition, and the intended recovery function of the critical habitat at the provincial and range-wide scale; (2) the Environmental Baseline, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the Effects of the Action, which determines the direct and indirect effects of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected critical habitat units and; (4) Cumulative Effects which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on smelt critical habitat are evaluated in the context of the range-wide condition of the critical habitat at the provincial and range-wide scales, taking into account any cumulative effects, to determine if the critical habitat range-wide will remain functional (or will retain capable habitat) to serve its intended recovery role for the smelt.

The analysis in this biological opinion places an emphasis on using the intended range-wide recovery function of smelt critical habitat and the role of the action area relative to that intended function as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

Status of the Species

Giant Garter Snake
Please refer to the Giant Garter Snake (*Thamnophis gigas*) 5-year Review: Summary and Evaluation for the current status of the species (Service 2006).

Environmental Baseline
Suitable habitat for the snake exists along the western border of both the North and South Basins of the West Sacramento GRR Project. In the North Basin, some additional suitable habitat can be found along the Sacramento Bypass. In the South Basin, drainages along the toe of the South Cross Levee may also provide habitat for the snake. However, most of the developed and undeveloped lands within the City of West Sacramento do not provide suitable habitat for the snake.

There are 28 occurrence records of the snake within 5 miles of the City of West Sacramento (CDFW 2014b). The closest occurrences are about 1.5 miles west of the Sacramento Bypass Training Levee, while 11 occurrences are to the north in the Natomas Basin, across the Sacramento

River from West Sacramento. There are 77 CNDDB occurrences within 10 miles of West Sacramento (CDFW 2014b). Seven of the occurrence records within 10 miles of West Sacramento are across the Sacramento River and southeast of the City of Sacramento, near Elk Grove. Giant garter snakes are apparently absent from larger rivers, and from wetlands with sand, gravel, or rock substrates (R. Hansen 1980; Rossman and Stewart 1987; Brode 1988; G. Hansen 1988; Brode and Hansen 1992). The North and South Basins contain limited suitable snake aquatic habitat in drainages and canals, yet the Sacramento River generally does not offer suitable habitat and is a significant barrier to snake movement.

Valley Elderberry Longhorn Beetle

For the most recent comprehensive assessment of the range-wide status of the beetle, please refer to the *Withdrawal of the Proposed Rule to Remove the Valley Elderberry Longhorn Beetle from the Federal List of Endangered and Threatened Wildlife; Proposed Rule, Withdrawal* (Service 2014a).

Environmental Baseline

The majority of lands within North and South Basins of West Sacramento are urban and suburban lands in private ownership. Suitable habitat for the beetle (i.e., elderberry shrubs) occurs throughout the City of West Sacramento. Although the status of the beetle and its habitat on most of these private lands is unknown, there are documented occurrences of beetles in both the North and South Basins (CDFW 2014b). In the South Basin, occurrence number 208 near river mile 52 of the Sacramento River, and occurrence number 209 along a railroad access north of Davis road, have identified both male and female beetles. At occurrence number 209, one female was observed laying eggs in 2006 (CDFW 2014b). In the North Basin, occurrences 18, 28, 29, and 56 have all documented elderberry shrubs with exit holes in stems, a sign of beetle presence.

Delta Smelt

Listing Status

The Service proposed to list the smelt as threatened with proposed critical habitat on October 3, 1991 (Service 1991). The Service listed the smelt as threatened on March 5, 1993, and designated critical habitat for this species on December 19, 1994 (Service 1994). The smelt was one of eight fish species addressed in the Recovery Plan for the Sacramento–San Joaquin Delta Native Fishes (Service 1995). This recovery plan is currently under revision. A 5-year status review of the smelt was completed on March 31, 2004 (Service 2004). The 2004 review affirmed the need to retain the smelt as a threatened species. A 12-month finding on a petition to reclassify the delta smelt was completed on April 7, 2010 (Service 2010). After reviewing all available scientific and commercial information, the Service determined that re-classifying the smelt from a threatened to an endangered species was warranted but precluded by other higher priority listing actions (Service 2010).

Distribution

The smelt is endemic to the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (Bay-Delta) in California, and is restricted to the area from San Pablo Bay upstream through the Delta in Contra Costa, Sacramento, San Joaquin, Solano, and Yolo counties (Moyle 2002). Their range extends from San Pablo Bay upstream to Verona on the Sacramento River and Mossdale on the San Joaquin River. The smelt was formerly considered to be one of the most common pelagic fish in the upper Sacramento-San Joaquin Estuary.

Description

Delta smelt are a small, slender bodied fish of the Osmeridae (smelts) (Moyle 2002). They are nearly translucent with a steely-blue sheen to their sides and a pronounced odor reminiscent of cucumber (Moyle 2002). Although delta smelt have been recorded to reach lengths of up to 120 mm (4.7 in) (Moyle 2002), catch data from 1992 - 2004 showed mean fork length to be 54.1 ± .01 mm (Bennett 2005; Sweetnam 1999). Delta smelt are also identifiable by their relatively large eye to head size (Moyle 2002) and their small, translucent adipose fin located between the dorsal and caudal fins. Occasionally one chromatophore may be found between the mandibles, but most often there is none (Moyle 2002).

The delta smelt is one of six species currently recognized in the Hypomesus genus (Bennett 2005). Genetic analyses have confirmed that delta smelt presently exists as a single intermixing population (Stanley et al. 1995; Trenham et al. 1998; Fisch et al. 2011). Within the genus, delta smelt are most closely related to surf smelt (*H. pretiosis*), a species common along the western coast of North America. The wakasagi *(H. nipponensis)*, an anadromous western Pacific smelt species introduced to Central Valley reservoirs in 1959, is thought to be seasonally sympatric with the delta smelt in the estuary (Trenham et al. 1998). Despite morphological similarities, allozyme studies have demonstrated that wakasagi and delta smelt are genetically distinct and presumably derived from different marine ancestors (Stanley et al. 1995).

Life History

Adult delta smelt spawn during the late winter and spring months, with most spawning occurring during April through mid-May (Moyle 2002). Spawning occurs primarily in sloughs and shallow edge areas in the Delta and has been recorded in Suisun Marsh and the Napa River (Moyle 2002). Most spawning occurs at temperatures between 12-18°C. Spawning may occur at temperatures up to 22°C, but hatching success of the larvae is very low (Bennett 2005). Fecundity of females ranges from about 1,200 to 2,600 eggs, and is correlated with female size (Moyle 2002). In captivity, females survive after spawning and develop a second clutch of eggs (Mager et al. 2004) and field collections of ovaries containing eggs of different size and stage indicate that this also occurs in the wild (Adib-Samii 2008). While most adults do not survive to spawn a second season, a small percentage do (<5 percent) (Moyle 2002; Bennett 2005) and are typically larger (90-110 mm Standard Length [sdl]). These females may contribute disproportionately to the population's egg supply (Moyle 2002 and references therein) since two-year-old females may have 3-6 times as many ova as first year spawners.

The locations in the Delta where newly hatched larvae are present most likely indicates spawning occurrence and most of what is known about delta smelt spawning habitat in the wild is inferred from the location of spent females and young larvae captured in the DFW's Spring Kodiak Trawl (SKT) (CDFW 2014a) and 20-mm Survey, respectively. In the laboratory, delta smelt spawned at night (Baskerville-Bridges et al. 2000; Mager et al. 2004). Other smelts, including marine beach spawning species and estuarine populations are secretive spawners, entering spawning areas during the night and leaving before dawn. If this behavior is exhibited by delta smelt, then delta smelt distribution based on the SKT, which is conducted during daylight hours in offshore habitats, may reflect general regions of spawning activity, but not actual spawning sites.

Delta smelt spawning has only been directly observed in the laboratory. Consequently, what is known about the mechanics of smelt spawning is derived from laboratory observations and observations of related smelt species. Delta smelt eggs are 1 millimeter diameter and are adhesive

and negatively buoyant (Moyle 2002; Mager et al. 2004; Wang 1986; Wang 2007). Laboratory observations indicate that delta smelt are broadcast spawners, discharging eggs and milt close to the bottom over substrates of sand and/or pebble in current (DWR and Reclamation 1994; Brown and Kimmerer 2002; Lindberg et al. 1997; Wang 2007). Spawning over gravel or sand can also aid in the oxygenation of smelt eggs and eggs that are laid in silt or muddy substrates might get buried or smothered, preventing their oxygenation from water flow (Lindberg pers. comm. 2011). The eggs of surf smelts and other beach spawning smelts adhere to sand particles, which keeps them negatively buoyant but not immobile, as the sand may "tumble" them with water currents and turbulence (Hay 2007). It is not known whether delta smelt eggs "tumble incubate" in the wild, but tumbling of eggs may moderately disperse them, which might reduce predation risk within a localized area.

Mager et al. (2004) reported that embryonic development to hatching takes 11-13 days at 14-16° C for delta smelt, and Baskerville-Bridges et al. (2000) reported hatching of delta smelt eggs after 8-10 days at temperatures between 15-17° C. Wang (2007) reported high hatching rates at temperatures between 14-17° C. At hatching and during the succeeding three days, larvae are buoyant, swim actively near the water surface, and do not react to bright direct light (Mager et al. 2004). As development continues, newly hatched delta smelt become semi-buoyant.

Analyses of otoliths indicate larval delta smelt grow to twice their size after 40 days (Bennett 2005), and by 70 days, most wild fish were 30-40 mm long and beyond the larval stage. This suggests there is a strong selective pressure for rapid larval growth in nature, a situation that is typical for fish in general (Houde 1987). Successful feeding seems to depend on a high density of food organisms and turbidity, and increases with stronger light conditions (Baskerville-Bridges et al. 2000; Mager et al. 2004; Baskerville-Bridges et al. 2004). The food available to larval smelt is constrained by mouth gape and status of fin development. Larval smelt cannot capture as many kinds of prey as larger individuals, but all life stages have small gapes that limit their range of potential prey. Prey availability is also constrained by habitat use, which affects what types of prey are encountered. Larval smelt are visual feeders and their ability to see prey in the water is enhanced by turbidity (Baskerville-Bridges et al. 2004). Thus, smelt diets are largely comprised of small crustacea that inhabit the estuary's turbid, low-salinity, open-water habitats (i.e., zooplankton). Larval smelt have particularly restricted diets (Nobriga 2002) and they do not feed on the full array of zooplankton with which they co-occur; they mainly consume three copepods, *Eurytemora affinis*, *Pseudodiaptomus forbesi*, and freshwater species of the family Cyclopidae. Further, the diets of first-feeding smelt larvae are largely restricted to the larval stages of these copepods; older, larger life stages of the copepods are increasingly targeted as the smelt larvae grow, their gape increases, and they become stronger swimmers.

The triggers for, and the duration of, delta smelt larval movement from spawning areas to rearing areas are not known. Most larvae gradually move downstream toward the two parts per thousand isohaline (X2), where X2 is scaled as the distance in kilometers from the Golden Gate Bridge (Jassby et al. 1995). Young-of-the-year smelt rear in the low-salinity zone (LSZ) from late spring through fall and early winter. Once in the rearing area growth is rapid, and juvenile fish are 40-50 mm sdl by early August (Erkkila et al. 1950; Ganssle 1966; Radtke 1966). They reach adult size (55-70 mm sdl) by early fall (Moyle 2002) and smelt growth slows considerably (only 3-9 mm total) during the fall months, presumably because most of the energy ingested is being directed towards gonadal development (Erkkila et al. 1950; Radtke 1966).

Population Dynamics and Abundance Trends- CDFW conducts several long-term monitoring surveys that have been used to index the relative abundance of smelt. The 20-mm Survey (CDFW 2014a) has been conducted every year since 1995 and samples April-June, targeting late-stage smelt larvae. The summer townet survey (TNS) has been conducted nearly every year between June-August, since 1959, and targets 38-mm striped bass, but collects similar-sized juvenile smelt. The FMWT has been conducted nearly every year since 1967, and like the TNS, the survey targets age-0 striped bass but collects smelt > 40 mm in length. The FMWT samples from September through December. The smelt catch data and relative abundance indices derived from these sampling programs have been used in numerous publications (e.g., Stevens and Miller 1983; Moyle et al. 1992; Jassby et al. 1995; Kimmerer 2002b; Dege and Brown 2004; Bennett 2005; Feyrer et al. 2007; Sommer et al. 2007; Kimmerer 2008; Newman 2008; Nobriga et al. 2008; Kimmerer et al. 2009; Mac Nally et al. 2010; Thomson et al. 2010; Feyrer et al. 2011; Maunder and Deriso 2011) and the abundance index time series documents the long-term decline of the smelt.

At all life stages, delta smelt are found in greatest abundance in the water column and usually not in close association with the shoreline. They inhabit open, surface waters of the Delta and Suisun Bay, where they presumably aggregate in loose schools where conditions are favorable (Moyle 2002). In years of moderate to high Delta outflow, delta smelt larvae are abundant in the Napa River, Suisun Bay and Montezuma Slough, but the degree to which these larvae are produced by locally spawning fish versus the degree to which they originate upstream and are transported by tidal currents to the bay and marsh is uncertain.

Sampling of larval delta smelt in 1989 and 1990 suggested that spawning occurred in the Sacramento River; in Georgiana, Prospect, Beaver, Hog, and Sycamore sloughs; in the San Joaquin River adjacent to Bradford Island and Fisherman's Cut; and possibly other areas (Wang 1991). However, in recent years, the densest concentrations of both spawners and larvae have been recorded in the Cache Slough/Sacramento Deepwater Ship Channel complex in the North Delta. Some delta smelt spawning occurs in the Napa River, Suisun Bay and Suisun Marsh during wetter years (Sweetnam 1999; Wang 1991; Hobbs et al. 2007). Early stage larval delta smelt have also been recorded in Montezuma Slough near Suisun Bay (Wang 1986).
The timing of spawning may affect delta smelt population dynamics. Lindberg (2011) has suggested that smelt larvae that hatch early, around late February, have an advantage over larvae hatched during late spawning in May. Early season larvae have a longer growing season and may be able to grow larger faster during more favorable habitat conditions in the late winter and early spring. An early growing season may result in higher survivorship and a stronger spawning capability for that generation. Larvae hatched later in the season have a shorter growing season which effectively reduces survivorship and spawning success for the following spawning season.

Early statistical assessments of delta smelt population dynamics concluded that at best, the relative abundance of the adult delta smelt population had only a very weak influence on subsequent juvenile abundance (Sweetnam and Stevens 1993). Thus, early attempts to describe abundance variation in delta smelt ignored stock-recruit effects and researchers looked for environmental variables that were directly correlated with interannual abundance variation (e.g., Stevens and Miller 1983; Moyle et al. 1992; Sweetnam and Stevens 1993; Herbold 1994; Jassby et al. 1995). Because delta smelt live in a habitat that varies in size and quality with Delta outflow, the authors cited above searched for a linkage between Delta outflow (or X2) and the TNS and FMWT indices. Generally, these analyses did not find strong support for an outflow-abundance linkage, which led to a prevailing conceptual model that multiple interacting factors had caused the delta smelt decline (Moyle et al. 1992; Bennett

and Moyle 1996; Bennett 2005). It has also recently been noted that delta smelt's FMWT index is partly influenced by concurrent environmental conditions (Feyrer et al. 2007; 2011). This may be a partial explanation for why few analyses could consistently link springtime environmental conditions to delta smelt's fall index.

Delta smelt abundance plays an important role in subsequent abundance (Bennett 2005; Maunder and Deriso 2011). Bennett (2005) assessed data from CDFW's FMWT and TNS, and concluded that two-year-old delta smelt might play an important role in delta smelt population dynamics, that it was not clear whether juvenile production was a density-independent or -dependent function of adult abundance, and that adult production is a density-dependent function of juvenile abundance. He also concluded that the carrying capacity of the estuary to support this life-stage transition had declined over time. These conclusions are also supported by Maunder and Deriso (2011).

Delta smelt population dynamics may have also changed over time. Previous publications have reported a delta smelt step-decline during 1981-1982 (Kimmerer 2002b; Thomson et al. 2010). Prior to this decline, the stock-recruit data are consistent with "Ricker" type density-dependence where increasing adult abundance resulted in decreased juvenile abundance. Since the decline, recruitment has been positively and essentially linearly related to prior adult abundance, suggesting that reproduction has been basically density-independent for about the past 30 years. This means that since the early 1980s, more adults translates into more juveniles and fewer adults translates into fewer juveniles without being "compensated for" by density-dependence.

In contrast to the transition among generations, the weight of scientific evidence strongly supports the hypothesis that, at least over the history of Interagency Ecological Program fish monitoring, delta smelt has experienced density-dependence during the juvenile stage of its life cycle (Bennett 2005; Maunder and Deriso 2011). This has been inferred because, statistically, the FMWT index does not increase linearly with increases in the TNS index. Rather, the best-fitting relationships between the TNS index and the FMWT index show the FMWT indices approach an asymptote as the TNS indices increases, or possibly even declines at the highest TNS indices.

From a species conservation perspective, the most relevant aspect of this juvenile density dependence is that the carrying capacity of the estuary for delta smelt has declined (Bennett 2005). Thus, the delta smelt population decline has occurred for two basic reasons. First, the compensatory density-dependence that historically enabled juvenile abundance to rebound from low adult numbers stopped happening. The reason is still not known, but the consequence of the change is that for the past several decades, adult abundance drives juvenile production in a largely density-independent manner. Thus, if numbers of adults or adult fecundity decline, juvenile production will also decline (Kimmerer 2011). Second, because juvenile carrying capacity has declined, juvenile production hits a "ceiling" at a lower abundance than it once did. This limits adult abundance and possibly per capita fecundity, which cycles around and limits the abundance of the next generation of juveniles. The mechanism causing carrying capacity to decline is likely due to the long-term accumulation of deleterious habitat changes – both physical and biological – during the summer-fall (Bennett et al. 2008; Feyrer et al. 2007; 2011; Maunder and Deriso 2011).

Habitat

The existing physical appearance and hydrodynamics of the Delta have changed substantially from the environment in which native fish species like delta smelt evolved. The Delta once consisted of tidal marshes with networks of diffuse dendritic channels connected to floodplains of wetlands and

upland areas (Moyle 2002). The in-Delta channels were further connected to drainages of larger and smaller rivers and creeks entering the Delta from the upland areas. In the absence of upstream reservoirs, freshwater inflow from smaller rivers and creeks and the Sacramento and San Joaquin Rivers were highly seasonal and more strongly and reliably affected by precipitation patterns than they are today. Consequently, variation in hydrology, salinity, turbidity, and other characteristics of the Delta aquatic ecosystem was greater in the past than it is today (Kimmerer 2002a). The following is a brief description of the changes that have occurred to delta smelt's habitat.

Changes to the LSZ: There have been documented changes to the delta smelt's LSZ habitat that have led to present-day habitat conditions. The close association of delta smelt with the San Francisco estuary LSZ has been known for many years (Stevens and Miller 1983; Moyle et al. 1992). Peterson (2003) developed a conceptual model that hypothesized how, "stationary and dynamic components of estuarine habitats" interacted to influence fisheries production in tidal river estuaries. Peterson's model suggests that when the dynamic and static aspects of estuarine habitat sufficiently overlap, foraging, growth, density, and survival are all high, and that enables fish production to outpace losses to predators. The result is high levels of successful recruitment of new individuals. The model also hypothesizes that when the dynamic and static aspects of an estuarine habitat do not sufficiently overlap, foraging, growth, density, and survival are impaired such that losses to predators increase and recruitment of new individuals decreases. This model was developed specifically for species spawned in marine environments that were subsequently transported into estuaries. However, the concept of X2, which was developed in the San Francisco estuary to describe how freshwater flow affected estuarine habitat (Jassby et al. 1995), played a role in the intellectual development of Peterson's model.

Current information indicates the most suitable delta smelt habitat is when low-salinity water is near 20°C, highly turbid, oxygen saturated, low in contaminants, supports high densities of calanoid copepods and mysid shrimp (Moyle et al. 1992; Lott 1998; Nobriga 2002), and occurs over comparatively static 'landscapes' that support sandy beaches and bathymetric variation that enables the fish and their prey to aggregate (Kimmerer et al. 2002a; Bennett et al. 2002; Hobbs et al. 2006). Almost every component listed above has been degraded over time and the Service has determined that this accumulation of habitat change is the fundamental reason or mechanism that has caused delta smelt to decline.

Alterations to estuarine bathymetry and salinity distribution- The position of the LSZ, where delta smelt rear, has changed over the years. The first major change in the LSZ was the conversion of the landscape over which tides oscillate and river flows vary (Moyle et al. 2010). Most of the historic wetlands within the system were diked and reclaimed for agriculture or other human uses by 1920 (Atwater et al. 1979) and channels were dredged to accommodate shipping traffic from the Pacific Ocean and San Francisco Bay to ports in Sacramento and Stockton. These changes left Suisun Bay and the confluence of the Sacramento-San Joaquin Rivers as the largest and most bathymetrically variable places in the LSZ. This region remained a highly productive nursery for many decades (Stevens and Miller 1983; Moyle et al. 1992; Jassby et al. 1995); however, the deepened channels required more freshwater outflow to maintain the LSZ in the large Suisun Bay and at the confluence than was once required (Gartrell 2010).

The construction of the Central Valley Water Project and the State Water Project not only provided water supply for urban, agricultural and industrial users, but also provided water needed to combat salinity intrusion into the Delta, which was observed by the early 20th century. California's demand

for freshwater continues to increase and the seasonal salinity intrusion perpetually reduces the temporal overlap of the LSZ (indexed by X2) within the Suisun Bay, especially in the fall (Feyrer et al. 2007; 2011). Consequently, a major habitat change in the Delta has been in the frequency with which the LSZ is maintained in Suisun Bay for any given amount of precipitation. There was a step-decline in the LSZ in 1977 from which it has never recovered for more than a few years at a time. Based on model forecasts of climate change and water demand, this trend is expected to continue (Feyrer et al. 2011).

Summer and fall environmental quality has decreased overall in the Delta because outflows are lower and water transparency is higher. The confluence of the Sacramento and San Joaquin Rivers has, as a result, become increasingly important as a rearing location for delta smelt, with physical environmental conditions constricting the species range to a relatively narrow area (Feyrer et al. 2007; Nobriga et al. 2008). This has increased the likelihood that most of the juvenile population is exposed to chronic and cyclic environmental stressors, or catastrophic events. For instance, all seven delta smelt collected during the September 2007 fall mid-water trawl (FMWT) survey were captured at statistically significantly higher salinities than what will be expected based upon historical distribution data generated by Feyrer et al. (2007). During the same year, the annual bloom of toxic cyanobacteria (Microcystis aeruginosa) spread far downstream to the west Delta and beyond during the summer (Lehman et al. 2005), and this has been suggested as an explanation for the anomaly in the distribution of delta smelt relative to water salinity levels (USBR 2008).

Turbidity: From 1999 to present, the Delta experienced a change in estuarine turbidity that culminated in an estuary-wide step-decline in 1999 (Schoellhamer 2011). Since delta smelt associate with highly turbid waters, there is a negative correlation between the frequency of delta smelt occurrence in trawls during the summer, fall and early winter, at a given sampling station with increasing clarity, or Secchi depth (Feyrer et al. 2007, Nobriga et al. 2008). This is very consistent with behavioral observations of captive delta smelt (Nobriga and Herbold 2008). Few daylight trawls catch delta smelt at Secchi depths over 0.50 m and capture probabilities for delta smelt are highest at 0.40 m or less. Turbid waters are thought to increase foraging efficiency (Baskerville-Bridges et al. 2004) and reduce the risk of predation for delta smelt.

Temperature: Delta smelt of all sizes are found in the main channels of the Delta and Suisun Marsh and the open waters of Suisun Bay where the water is well oxygenated and temperatures are usually less than 25° C in summer (Nobriga et al. 2008). Swanson and Cech (1995) and Swanson et al. (2000) indicate delta smelt tolerate a range of temperatures (<8° C to >25° C), however warmer water temperatures >25° C restrict their distribution more than colder water temperatures (Nobriga and Herbold 2008). Currently, delta smelt are subjected to thermally stressful temperatures every summer, and all available regional climate change projections predict central California will be warmer still in the coming decades (Dettinger 2005). Water temperatures are presently above 20°C for most of the summer in core habitat areas, sometimes even exceeding the nominal lethal limit of 25°C for short periods. Coldwater fishes begin to have behavioral impairments (Marine and Cech 2004) and lose competitive abilities (Taniguchi et al. 1998) prior to reaching their thermal tolerance limits. Thus, the estuary can already be considered thermally stressful to delta smelt and can only become more so if temperatures warm in the coming decades.

Foraging Ecology: Delta smelt feed primarily on small planktonic crustaceans, and occasionally on insect larvae (Moyle 2002). Historically, the main prey of delta smelt was the euryhaline copepod *Eurytemora affinis* and the euryhaline mysid *Neomysis mercedis*. The slightly larger *Pseudodiaptomus forbesi*

has replaced *E. affinis* as a major prey source of delta smelt since its introduction into the Bay-Delta (Moyle 2002). Another smaller copepod, *Limnoithona tetraspina*, was introduced to the Bay-Delta in the mid-1990s and is now one of the most abundant copepods in the LSZ, but not abundant in delta smelt diets. *Acartiella sinensis*, a calanoid copepod species that invaded the Delta at the same time as *L. tetraspina*, also occurs at high densities in Suisun Bay and in the western Delta over the last decade. Delta smelt eat these newer copepods, but Pseudodiaptomus remains their dominant prey (Baxter et al. 2008).

River flows influence estuarine salinity gradients and water residence times and thereby affect both habitat suitability for benthos and the transport of pelagic plankton upon which delta smelt feed. High tributary flow leads to lower residence time of water in the Delta, which generally results in lower plankton biomass (Kimmerer 2004). Higher residence times, which result from low tributary flows, can result in higher plankton biomass, but water diversions, overbite clam grazing (Jassby et al. 2002), and possibly contaminants (Baxter et al. 2008) remove a lot of plankton biomass when residence times are high. Delta smelt cannot occupy much of the Delta anymore during the summer (Nobriga et al. 2008) and there is a potential disconnect between regions of high zooplankton abundance in the Delta and delta smelt distribution.

Aquatic Macrophytes: For many decades, the Delta's waterways were turbid and growth of submerged plants was apparently unremarkable. That began to change in the mid-1980s, when the Delta was invaded by the non-native plant, *Egeria densa*, a fast-growing aquatic macrophyte that has now taken hold in many shallow habitats throughout the Delta (Brown and Michnuik 2007; Hestir 2010). The large canopies formed by *E. densa* and other non-native species of submerged aquatic vegetation (SAV) have physical and biological consequences for the ecosystem (Kimmerer et al. 2008) and delta smelt. First, the dense nature of SAV promotes sedimentation of particulate matter from the water column, which increases water transparency that then limits the amount of habitat available for delta smelt (Feyrer et al. 2007; Nobriga et al. 2008). Second, dense SAV canopies provide habitat for a suite of non-native fishes that occupy the Delta, displacing native fishes (Nobriga et al. 2005; Brown and Michniuk 2007) and increasing predation pressure on delta smelt. Third, the rise in SAV over the last three decades has led to a shift in the dominant trophic pathways that fuel fish production in the Delta. Until the latter 1980s, the food web of most fishes was often dominated by mysid shrimp (Feyrer et al. 2003) that were subsidized by phytoplankton food sources (Rast and Sutton 1989). Most littoral and demeral fishes of the Delta have diets dominated by the epibenthic amphipods that eat SAV detritus or the epiphytic algae attached to SAV (Grimaldo et al. 2009). Lastly, SAV can overwhelm littoral habitats (inter-tidal shoals and beaches) where delta smelt may spawn making them unsuitable for spawning.

Predators: Nothing is known about the historic predators of delta smelt or their possible influence on delta smelt population dynamics. Fish eggs and larvae can be opportunistically preyed upon by many invertebrate and vertebrate animals. The eggs and newly-hatched larvae of delta smelt are thought to be prey for Mississippi silversides (Bennett 2005), and potentially yellowfin goby, centrarchids, and Chinook salmon. Centrarchid fishes and Chinook salmon smolts released in the Delta for research may prey on larval delta smelt (Brandes and McLain 2001; Nobriga and Chotkowski 2000) and studies during the early 1960s found delta smelt were an occasional, but rare, prey fish for striped bass, black crappie and white catfish (Turner and Kelley 1966). Since delta smelt were a comparatively rare fish historically, it is not surprising that they were also a rare prey item.

The introduction of striped bass into the San Francisco Estuary in 1879 added a permanently resident, large piscivorous fish to the LSZ. The LSZ is a habitat not known to have had an equivalent predator prior to the establishment of striped bass (Moyle 2002). The current influence of striped bass and other predators on delta smelt population dynamics is unknown, mainly because predator effects on rare prey are extremely difficult to quantify. Delta smelt were observed in the stomach contents of striped bass and other fishes in the 1960s (Stevens 1963; Turner and Kelley 1966), but have not been in more recent studies (Feyrer et al. 2003; Nobriga and Feyrer 2007).

Potential native predators of juvenile and adult delta smelt will have included numerous bird and fish species, which may be reflected in delta smelt's life-history. Annual fish species, also known as "opportunistic strategists", are adapted to high mortality rates in the adult stage (Winemiller and Rose 1992). This high mortality is usually due to predation or highly unpredictable environmental conditions, both of which could have characterized the ancestral niche of delta smelt.

Predation is a common source of density-dependent mortality in fish populations (Rose et al. 2001), thus, it is possible that predation was a mechanism that historically generated the density-dependence observation in delta smelt population dynamics that has been noted by Bennett (2005) and Maunder and Deriso (2011). As is the case with other fishes, the vulnerability of delta smelt to predators may be influenced primarily by habitat suitability. It is widely documented that pelagic fishes, including many smelt species, experience lower predation risks under turbid water conditions (Thetmeyer and Kils 1995; Utne-Palm and Stiansen 2005; Horpilla et al. 2004,). Growth rates, a result of feeding success plus water temperature, are also well known to affect fishes' cumulative vulnerability to predation (Sogard 1997).

Competition: It has been hypothesized that delta smelt are adversely affected by competition from other introduced fish species that use overlapping habitats, including Mississippi silversides, (Bennett and Moyle 1996) striped bass, and wakasagi (Sweetnam 1999). Laboratory studies show that delta smelt growth is inhibited when reared with Mississippi silversides (Bennett 2005) but there is no empirical evidence in the wild to support this conclusion.

The LSZ historically had the highest primary productivity and is where zooplankton populations were historically most dense (Knutson and Orsi 1983; Orsi and Mecum 1996). However, since the introduction of the overbite clam, this has not always been true (Kimmerer and Orsi 1996). There is some speculation that the overbite clam competes with delta smelt for copepod nauplii (Nobriga and Herbold 2008) but it is unknown how intensively overbite clam grazing and delta smelt directly compete for food.

Contaminants: Contaminants can change ecosystem functions and productivity through numerous pathways. However, contaminant loading and its ecosystem effects within the Delta are not well understood. Although a number of contaminant issues were first investigated during the Pelagic Organism Decline (POD) years, concern over contaminants in the Delta is not new. Current science suggests the possible link between contaminants and the POD may be the effects of contaminant exposure on prey items, resulting in an indirect effect on the survival of POD species (Johnson et al. 2010). Pyrethroids are of particular interest because use of these pesticides has increased within the Delta watershed (Amweg et al. 2005, Oros and Werner 2005). Urban source waters with pyrethroid pesticides have shown toxicity to the amphipod *Hyalella azteca*, and high mortality rates and swimming impairment in fishes (Weston and Lydy 2010).

The association of delta smelt spawning with turbid winter runoff and the association of pesticides including pyrethroids with sediment is of potential concern. Persistent confinement of the spawning population of delta smelt to the Sacramento River increases the likelihood that a substantial portion of the spawners will be affected by a catastrophic event or localized chronic threat. For instance, large volumes of highly concentrated ammonia released into the Sacramento River from the Sacramento Regional County Sanitation District may affect embryo survival or inhibit prey production. Further, agricultural fields in the Yolo Bypass and surrounding areas are regularly sprayed by pesticides, and water samples taken from Cache Slough sometimes exhibited toxicity to *H. azteca* (Werner et al. 2008; 2010). The extent to which delta smelt larvae are exposed to contaminants varies with flow entering the Delta, where flow pulses during spawning increase exposure to many pesticides (Kuivila and Moon 2004) but decrease ammonia concentrations from wastewater treatment plants. The thresholds of toxicity for delta smelt for most of the known contaminants have not been determined, but the exposure to a combination of different compounds increases the likelihood of adverse effects.

Delta Smelt Critical Habitat

The Service designated critical habitat for the delta smelt on December 19, 1994 (Service 1994). The geographic area encompassed by the designation includes all water and all submerged lands below ordinary high water and the entire water column bounded by and contained in Suisun Bay (including the contiguous Grizzly and Honker Bays); the length of Goodyear, Suisun, Cutoff, First Mallard (Spring Branch), and Montezuma sloughs; and the existing contiguous waters contained within the legal Delta (as defined in section 12220 of the California Water Code). Critical habitat is defined in section 3 of the Act as: (1) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the Act, on which are found those physical or biological features (a) essential to the conservation of the species and (b) that may require special management considerations or protection; and (2) specific areas outside the geographical area occupied by a species at the time it is listed, upon determination that such areas are essential for the conservation of the species. In determining which areas to designate as critical habitat, the Service considers those physical and biological features that are essential to a species' conservation and that may require special management considerations or protection (50 CFR 424.12(b)). The Service is required to list the known PCEs together with the critical habitat description. Such physical and biological features include, but are not limited to, the following:

1. Space for individual and population growth, and for normal behavior;
2. Food, water, air, light, minerals, or other nutritional or physiological requirements;
3. Cover or shelter;
4. Sites for breeding, reproduction, rearing of offspring, or dispersal; and
5. Generally, habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of a species.

The PCEs defined for the delta smelt were derived from its biological needs. In designating critical habitat for the delta smelt, the Service identified the following primary constituent elements essential to the conservation of the species: physical habitat, water, river flow, and salinity concentrations required to maintain delta smelt habitat for spawning, larval and juvenile transport, rearing, and adult migration. Specific areas that have been identified as important delta smelt spawning habitat include Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore sloughs and the Sacramento River in the Delta, and tributaries of northern Suisun Bay.

1. Physical habitat is defined as the structural components of habitat. Because delta smelt is a pelagic fish, spawning substrate is the only known important structural component of habitat. It is possible that depth variation is an important structural characteristic of pelagic habitat that helps fish maintain position within the estuary's LSZ (Bennett et al. 2002, Hobbs et al. 2006).

2. Water is defined as water of suitable quality to support various delta smelt life stages with the abiotic elements that allow for survival and reproduction. Delta smelt inhabit open waters of the Delta and Suisun Bay. Certain conditions of temperature, turbidity, and food availability characterize suitable pelagic habitat for delta smelt and are discussed in detail in the Status of the Species section above. Factors such as high entrainment risk and contaminant exposure can degrade this PCE even when the basic water quality is consistent with suitable habitat.

3. River flow is defined as transport flow to facilitate spawning migrations and transport of offspring to LSZ rearing habitats. River flow includes both inflow to and outflow from the Delta, both of which influence the movement of migrating adult, larval, and juvenile delta smelt. Inflow, outflow, and Old and Middle Rivers flow influence the vulnerability of delta smelt larvae, juveniles, and adults to entrainment at Banks and Jones. River flow interacts with the fourth PCE, salinity, by influencing the extent and location of the highly productive LSZ where delta smelt rear.

4. Salinity is defined as the LSZ nursery habitat. The LSZ is where freshwater transitions into brackish water; the LSZ is defined as 0.5-6.0 parts per thousand salinity (psu) (Kimmerer 2004). The 2 psu X2 is a specific point within the LSZ where the average daily salinity at the bottom of the water is 2 psu (Jassby et al. 1995). By local convention the location of the LSZ is described in terms of the distance from the 2 psu X2 to the Golden Gate Bridge; X2 is an indicator of habitat suitability for many San Francisco Estuary organisms and is associated with variance in abundance of diverse components of the ecosystem (Jassby et al. 1995, Kimmerer 2002b). The LSZ expands and moves downstream when river flows into the estuary are high. Similarly, it contracts and moves upstream when river flows are low. During the past 40 years, monthly average X2 has varied from San Pablo Bay (45 kilometers) to as far upstream as Rio Vista on the Sacramento River (95 kilometers). At all times of year, the location of X2 influences both the area and quality of habitat available for delta smelt to successfully complete their life cycle. In general, delta smelt habitat quality and surface area are greater when X2 is located in Suisun Bay. Both habitat quality and quantity diminish as the LSZ moves more frequently and further upstream, toward the confluence.

Environmental Baseline

Delta smelt critical habitat extends along the Sacramento River to the I Street Bridge, and marks the eastern boundary of both basins of the West Sacramento Project. Delta smelt critical habitat also includes the Sacramento River Deep Water Ship Channel, which extends along the western boundary of the West Sacramento GRR Project South Basin and separates the North and South Basins at the Port of Sacramento.

Monitoring surveys along the Sacramento River adjacent to project construction areas have confirmed the presence of the smelt in trawl surveys (Service 2014b) and shallow water seine net

surveys (Service 2014c). Trawl surveys conducted in March and April from Sherwood Harbor at River Mile 55, adjacent to the Sacramento River South levee, have recorded 51 smelt (Service 2012b). Similarly, one smelt was identified in a seine net survey at Sherwood Harbor in 2014, and over 50 smelt were netted between river miles 43 and 49, just downstream of the project South Basin, between 2012 and 2014 (Service 2014c). The surveys were conducted between November and April of successive years. The seine net surveys also noted 7 records of smelt adjacent to the project North Basin in February and March 2014, between river miles 60 and 62 (Service 2014c).

The Sacramento River Deep Water Ship Channel also provides suitable spawning habitat for the smelt (CDFW 2014c). At survey station 719, about 12 miles downstream of the South Cross Levee in the Sacramento Deep Water Ship Channel, March, 2014, 20mm surveys noted 48.84 smelt per 10,000 cubic meters, which is the highest catch rate of smelt in the Delta at that period. SKT trawl surveys during March and April of the past 3 years also showed the highest catch rates in the Delta (CDFW 2014a), demonstrating the importance of the Sacramento River Deep Water Ship Channel as a smelt spawning ground. In dry years, river flows can be expected to be relatively low, and hence the LSZ nursery habitat would move much further upstream, toward the project construction area.

Effects of the Proposed Action

Giant Garter Snake

Construction activities of the West Sacramento GRR Project, such as fill removal, grading, fill placement, wall construction, and vehicle movement will permanently degrade 30 acres of snake habitat, and results in temporary effects to 211 acres (Table 5). Permanent effects include the direct loss of snake habitat, while temporary effects result from seasonal construction activities that will be restored upon completion of the construction activities at each levee reach. Effects to the snake from the Southport Project portion of the West Sacramento GRR Project are noted in Appendix B.

Table 5. Effects on giant garter snake (*Thamnophis gigas*) habitat in the West Sacramento General Reevaluation Report Project, West Sacramento, Yolo County, California.[1]

Habitat	Temporary Effects	Permanent Effects
Aquatic Habitat	11	20
Upland Habitat[2]	200[1]	10

[1] The estimate of 200 acres is based on a worst-case scenario when considering necessary borrow material.

[2] Southport Project effects are included.

The Corps has proposed to compensate for the temporary loss of snake habitat through the purchase of snake credits from a Service-approved conservation bank at a ratio of 2:1. The Corps has proposed to compensate for the permanent loss of snake habitat through the purchase of snake credits from a Service-approved conservation bank at a ratio of 3:1.

Habitat affected by the snake includes rice fields, which offer many similarities to the historical, natural wetlands of the area around the City of West Sacramento. Open agricultural fields within the action area of the West Sacramento GRR Project are largely fallow or planted in wheat. These fields are not irrigated with standing water in a manner that mimics the natural wetlands used by the giant

garter snake. Although the drainage canals offer little in terms of prey base and vegetative cover, the drains lining the agricultural fields can provide avenues for snake travel.

Potential snake upland habitat is generally considered upland habitats within 200 feet of snake aquatic habitat. The Sacramento Bypass to the north, the Yolo Bypass to the west, and the South Cross Levee drainage canal to the south of the action area do provide suitable habitat for the snake. In the North Basin, work along the Sacramento Bypass Training Levee and Yolo Bypass Levees will border the Yolo Bypass, an area of agricultural and natural wetlands that provides suitable aquatic snake habitat. In the South Basin, work along the South Cross Levee, and along with the Sacramento Bypass west levee can provide suitable upland snake habitat.

Valley Elderberry Longhorn Beetle

As an Early Implementation Project, the Southport Project area along the South Sacramento River Levee was surveyed for elderberry shrubs 2011-2013. Surveys identified 41 shrubs containing 424 stems within the action area (Appendix B). An estimate of 18 shrubs (including 4 on inaccessible private lands) will be directly affected by construction activities, and will be removed and transplanted to the project offset floodplain area riparian zone if possible.

Transplanting the elderberry shrubs may cause them to die, become stressed, or become unhealthy due to transplanting. This may reduce the shrub's quality as habitat for the beetle, or impair production of habitat-quality stems in the future. Branches containing larvae may be cut, broken, or crushed during the transplantation process. These effects to the shrubs may cause the beetle to be harmed, harassed, injured, or killed.

The remaining 23 elderberry shrubs within 100 feet of construction activities will be protected during construction activities by implementing the listed Conservation Measures for the beetle. These measures will reduce the likelihood that the health and survival of the elderberry shrubs would be adversely affected by project activities to the point that take of the beetle is not reasonably likely to occur.

For the West Sacramento GRR Project as a whole, shrub counts were extrapolated to provide reasonable effects estimates for the complete project (Table 6). An estimated 215 elderberry shrubs will be affected by the West Sacramento GRR Project. To provide a worst-case scenario for analyses, all shrubs are assumed to be in riparian habitat and with evidence of beetle presence (holes in stems). Based on the results of these analyses, 118.42 acres will be required for elderberry and associated native species compensation plantings (Service 1999a). As part of the proposed conservation measures, the Corps is planning to use at least 13.51 acres of the Southport Project offset area riparian zone as an area for elderberry compensation plantings for the Southport Project portion of the West Sacramento GRR Project. The suitability of the offset area riparian zone for additional compensation will be dependent on site-specific conditions; additional compensation for the beetle will be acquired offsite.

Delta Smelt and Delta Smelt Critical Habitat

Potential spawning habitat includes shallow channel edge waters of the Sacramento River and Sacramento River Deep Water Ship Channel. Potential construction-related effects to smelt physical

Table 6. Estimates of elderberry shrubs affected by the West Sacramento General Reevaluation Report Project, West Sacramento, Yolo County, California.[1]

Location	Stem Diameter	Holes	Number of Stems	Elderberry Ratios	Elderberry Plantings	Associate Ratios	Associate Plantings
Riparian	≥ 1 inch and ≤ 3 inches	Yes	1,524	4:1	5,588	2:1	10,580
Riparian	> 3 inches and < 5 inches	Yes	391	6:1	2,160	2:1	4,032
Riparian	≥ 5 inches	Yes	303	8:1	2,237	2:1	4,109
Totals[2]			2,218		9,985		18,721

[1] Information based on the Conservation Guidelines for the Valley Elderberry Longhorn Beetle (Service 1999a).

[2] Southport Project effects are included.

habitat would include disruption of spawning activities, disturbance or mortality of eggs and newly hatched larvae, alteration of spawning and incubation habitat, and loss of shallow water habitat for spawning. The Corps has estimated that 13.35 acres of shallow water habitat that may be used for spawning or dispersal will be permanently lost through the completion of the West Sacramento GRR Project. In contrast, 118.81 acres of suitable delta smelt shallow water habitat will be created by the project in the Southport Project offset area, for a net gain of 105.46 acres of shallow water habitat. The floodplain is designed to contain water during months (December – May) when smelt larva are most likely to be present.

The West Sacramento GRR Project could detrimentally affect delta smelt by increasing turbidity, increasing noise, reducing water quality, creating predator habitat, restricting channels, and changing water velocities. Re-suspended sediments may contain toxic substances which may interfere with the development of young delta smelt. The substrate upon which delta smelt may depend for egg attachment and refugia may become silted over or removed by the proposed actions. As shallow water habitat is removed and turbidity increased, the delta smelt's feeding, breeding, and sheltering would likely be reduced as food sources associated with the aquatic plants and found in the water column is destroyed, and habitat used for spawning substrate and refugia is eliminated.

Rock slope protection can limit the lateral mobility of a river channel, increase flow velocities (Sedell et al.1990), limit sediment transport, and thus eliminate bankside refugia areas (Gregory et al. 1991). In turn, many of the streamside effects of increased velocity are transferred downstream (Larsen and Greco 2002). Although work along the Sacramento River includes additional rock slope protection, the negative effects to shallow water habitat, both at the project construction areas and downstream along the Sacramento River, are expected to be offset by the creation of the riparian and floodplain area of the Southport Project. The offset floodplain area is designed to absorb much of the increased flow energy, instead of having it transferred downstream. The floodplain area is expected to provide more space for population growth, additional cover or shelter, and additional habitat that is, for the most part, protected from large fluctuations in river velocities.

Adult delta smelt migrate upstream between December and January and spawn between January and July, with a peak in spawning activity between April and mid-May (Moyle 2002). The above effects are reduced by the restriction of project in-water work to time periods when delta smelt eggs, larvae, and juveniles are not present and delta smelt adults are rarely present or present in low numbers, between August 1 and November 30. In addition, the above effects are further greatly reduced by the creation of suitable shallow water habitat in the Southport Project offset floodplain area.

However, the creation of the Southport Project offset floodplain area could introduce increased predation and competition from exotic species. Fishes introduced to the Sacramento-San Joaquin Delta, such as the largemouth bass (*Micropterus salmoides*) and smallmouth bass (*M. dolomieu*), thrive as predators in warm, shallow water habitat. Such introduced fish may increase predation pressure upon the delta smelt in newly designed shallow water habitat. Reduced feeding efficiency and ingestion rates due to introduced competition into the designed smelt habitat, such as from the wagasaki (*Hypomesus nipponensis*), could weaken and slow the growth of young delta smelt and make them more vulnerable to starvation and predation.

Cumulative Effects

Cumulative effects are those effects of future State, Tribal, county, local agency, and private actions that are reasonably certain to occur within the action area. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the Act.

The California Department of Finance (2013) has projected the population within Sacramento County to rise 65% from 2010 levels to 2060, while Yolo County similarly is expected to experience nearly 66% growth over the same period. The West Sacramento GRR Project will afford increased flood protection for a growing community, which in turn could increase human-based pressures incrementally on the federally-listed species. For example, drainage areas that may now be used by snakes as travel corridors may cease to be useful for snakes with the onset of increased human activity in close proximity to waterways with no appropriate snake cover. Also, project effects to the snake, beetle, and smelt are expected to extend for several years as project construction progresses sequentially over time. To minimize unavoidable effects to the federally-listed species, the Corps has proposed several compensatory measures that will be implemented and maintained in perpetuity.

Cumulative effects on the delta smelt and its designated critical habitat include the effects of point and non-point source chemical contaminant discharges. These contaminants include numerous pesticides and herbicides associated with discharges related to agricultural and urban activities. Implicated as potential sources of mortality for delta smelt, these contaminants may adversely affect delta smelt reproductive success and survival rates. Spawning habitat may also be affected if submersed aquatic plants used as substrates for adhesive egg attachment are lost due to toxic substances.

Additional cumulative effects may result from diversions of water that may entrain adult or larval fish or that may change outflows incrementally, either excluding delta smelt from Sacramento River flow or shifting the position of the delta smelt from its preferred habitat.

Conclusion

After reviewing the current status of the snake, beetle, smelt, and smelt critical habitat, the environmental baseline for the action area covered in this biological opinion, the effects of the proposed project, the cumulative effects, and the proposed conservation measures, it is the Service's biological opinion that the West Sacramento GRR Project, as proposed, is not likely to jeopardize the continued existence of these species. Also, the project will not result in net destruction or adverse modification of smelt critical habitat. The Service reached this conclusion because the anticipated level of take of the snake, beetle, and smelt, upon analyses of project effects in relation the environmental baseline for these species, will not rise to levels precluding the recovery of these species, or reduce the likelihood of survival of these species.

The West Sacramento GRR Project will contribute to the conservation of the snake by preserving suitable snake habitat at a conservation bank. Also, the description of the West Sacramento GRR Project contains the Southport Project, which includes the creation of an offset floodplain area that will provide riparian habitat with space for transplanting elderberry shrubs displaced by the project. Any additional offsite areas necessary for elderberry compensation will be protected in perpetuity. In addition, the offset floodplain area will provide a net gain in the amount of suitable smelt shallow water habitat during the spring months, when the area is most likely to be used by the smelt for feeding and reproduction.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service regulations at 50 CFR 17.3 as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the same regulations as an act which actually kills or injures wildlife. Harm is further defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps (1) fails to assume and implement the terms and conditions or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR §402.14(i)(3)].

Amount or Extent of Take

The Service anticipates incidental take of giant garter snakes will occur in the form of disturbance, harm, and harassment. Incidental take also may occur in the form of injury or death to snakes occupying levee holes or crevices unseen during construction. Within the West Sacramento GRR Project action area, effects to snakes at individual levee reaches will vary. Giant garter snakes are secretive and sensitive to human activities. Individual snakes are difficult to detect unless they are observed, undisturbed, at a distance. Most close-range observations represent chance encounters that are difficult to predict. In instances in which the total number of individuals anticipated to be taken cannot be determined, the Service may use the amount of habitat impacted as a surrogate; because the take of individuals anticipated will result from the destruction of the snake habitat, the quantification of suitable habitat serves as a direct surrogate for the snakes that will be lost. Over the course of project construction, the Service anticipates that all giant garter snakes found in 241 acres of habitat will be disturbed, harassed, harmed, or killed by project activities resulting in temporary impacts and permanent impacts, especially from dewatering, channel reconfiguration, and use of heavy equipment within or near aquatic habitat. Thirty acres of giant garter snake habitat may be permanently lost over the course of project construction.

Implementation of the West Sacramento GRR Project will result in the incidental take of the beetle resulting from project impacts to 215 elderberry shrubs with 2,218 stems one inch or greater in diameter at ground level. The life stage affected by this action will be the beetle larvae living within the stems of the elderberry shrubs. The life cycle of the beetle takes 1 or 2 years to complete, during which it spends most of its life in the larval stage. It is not possible to know how many beetle larvae are in the stems of any elderberry shrub, therefore the Service cannot quantify the total number of beetles that we anticipate will be taken as a result of the proposed action. Because the take of individuals anticipated will result from the destruction of the elderberry shrubs, the quantification of suitable habitat serves as a direct surrogate for the beetles that will be lost. Therefore, the Service anticipates take incidental to this project as the 215 elderberry shrubs with 2,218 stems one inch or greater in diameter at ground level that could potentially be destroyed.

The Service anticipates that incidental take of delta smelt will occur. However, the Service anticipates that any take of delta smelt will be difficult to detect and quantify for a number of reasons: they have a relatively small body size; they are relatively secretive; their presence in the Delta and associated areas coincides with relatively turbid conditions, which makes their detection difficult. Therefore, it is not possible to provide precise numbers of delta smelt that could be injured, harassed, harmed, or killed from the project. The Service anticipates that all delta smelt inhabiting up to 13.35 acres of shallow water habitat may be harmed, harassed, injured, or killed as a result of the project. Low mortality is anticipated because of the work restriction windows. Because the species is wide-ranging and its distribution varies from one year to the next, take may vary from year to year over the 19-year construction period. Additionally, losses of the species may be masked by seasonal fluctuations in fish presence. Upon implementation of the following reasonable and prudent measure, incidental take associated with the project in the form of harm, harassment, injury, or mortality to delta smelt, the Corps will become exempt from the prohibitions described under section 9 of the Act.

Effect of the Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the snake, beetle, or smelt. Also, the West Sacramento GRR Project will not result in the destruction or adverse modification of designated critical habitat for the delta smelt.

Reasonable and Prudent Measure

The Service has determined that the following reasonable and prudent measure is necessary and appropriate to minimize the effects of the proposed project on the snake, beetle, and smelt:

1. All conservation measures proposed in the biological assessment, and as re-stated in the project description section of this biological opinion, must be fully implemented and adhered to. Further, this Reasonable and Prudent Measure shall be supplemented by the Terms and Conditions listed below.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the Corps must ensure compliance with the following terms and conditions, which implement the reasonable and prudent measure described above. These terms and conditions are nondiscretionary.

1. The Service shall be informed of any changes in project construction scheduling as soon as possible. Should the project schedule be altered from that described herein, the Corps must immediately reinitiate formal consultation as per 50 §CFR 402.16.

2. The Corps shall comply with the latest Conservation Guidelines for the Valley Elderberry Longhorn Beetle (Service 1999a). The Corps shall check with the Service before each construction season to ensure that any and all updates to these guidelines are incorporated into the project. The Service shall be informed of conservation area monitoring plans to ensure that success criteria outlined in these guidelines are accurately assessed.

3. To monitor whether the amount or extent of incidental take anticipated from implementation of the proposed project is approached or exceeded, the Corps shall adhere to the following reporting requirement. Should this anticipated amount or extent of incidental take be exceeded, the Corps must immediately reinitiate formal consultation as per 50 §CFR 402.16.

    a. For those components of the action that will result in habitat degradation or modification whereby incidental take in the form of harm is anticipated, the Corps will provide monthly updates to the Service with a precise accounting of the total acreage of habitat impacted. Updates shall also include any information about proposed changes in project implementation that result in habitat disturbance not described in the Project Description and not analyzed in this biological opinion.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities that can be implemented to further the purposes of the Act, such as preservation of endangered species habitat, implementation of recovery actions, or development of information or data bases. The Service is providing the following conservation recommendations:

1. The Corps should communicate with the Service to ensure that the most up to date plans for the recovery of each federally-listed species are recognized and followed:

    a. The Corps should work with the Service to assist us in meeting the goals of the latest Recovery Plan for the valley elderberry longhorn beetle, which currently is the Valley Elderberry Longhorn Beetle Recovery Plan (Service 1984);

    b. The Corps should work with the Service to assist us in meeting the goals of the latest Recovery Plan for the giant garter snake, which currently is the 1999 Draft Recovery Plan for the Giant Garter Snake (*Thamnophis gigas*) (Service 1999b); and

    c. The Corps should work with the Service to assist us in meeting the goals of the latest Recovery Plan for the delta smelt, which currently is the 1996 Recovery Plan for the Sacramento-San Joaquin Delta Native Fishes (Service 1996).

2. The Corps and WSAFCA should monitor the effectiveness of the offset floodplain area in providing spawning and rearing habitat, as well the effectiveness of the floodplain in providing juvenile and adult transport and migration

So the Service can be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendation.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the West Sacramento Project General Reevaluation Report Project in Yolo County, California. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (a) if the amount or extent of taking specified in the incidental take statement is exceeded; (b) if new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (c) if the identified action is subsequently modified in a manner that causes an effect to listed species or critical habitat that was not considered in the biological opinion; or (d) if a new species is listed or critical habitat designated that may be affected by the identified action.

If you have questions regarding the West Sacramento West Sacramento GRR Project, please contact Harry Kahler, Fish and Wildlife Biologist, or Doug Weinrich, Assistant Field Supervisor, at (916) 414-6600.

Sincerely,

Jennifer M. Norris
Field Supervisor

Enclosure:

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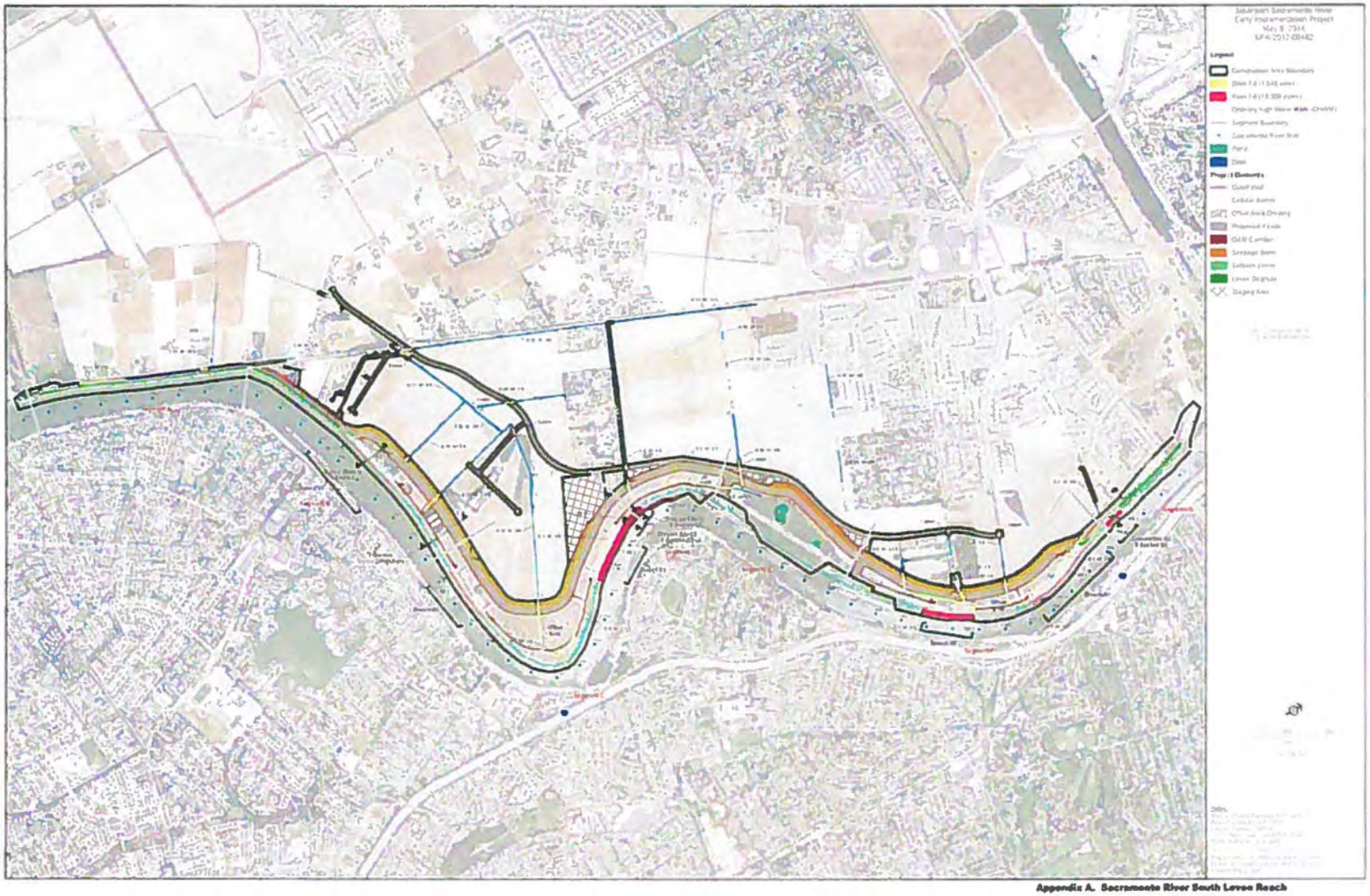
APPENDIX A

SOUTHPORT EARLY IMPLEMENTATION PROJECT

Project Plan View



Appendix A. Sacramento River South Levee Reach
Southport Early Implementation Project
West Sacramento General Reevaluation Report

APPENDIX B

SOUTHPORT EARLY IMPLEMENTATION PROJECT

Project Effects on Federally-Listed Species Within U.S. Fish and Wildlife Service Jurisdiction

Table B-1. Effects on giant garter snake (*Thamnophis gigas*) in the Southport Early Implementation Project action area of the West Sacramento General Reevaluation Report Project, West Sacramento, Yolo County, California.

Habitat	Temporary Effects	Permanent Effects
Aquatic Habitat	0	0
Upland Habitat	155	2.24

Table B-2. Estimates of elderberry shrubs affected by the Southport Project Early Implementation Project of the West Sacramento General Reevaluation Report Project, West Sacramento, Yolo County, California.[1]

Location	Stem Diameter	Holes	Number of Stems	Elderberry Ratios	Elderberry Plantings	Associate Ratios	Associate Plantings
Non-riparian	≥ 1 inch and ≤ 3 inches	No	6	1:1	6	1:1	6
		Yes	135	2:1	270	2:1	540
Non-riparian	> 3 inches and < 5 inches	No	1	2:1	2	1:1	2
		Yes	22	4:1	88	2:1	176
Non-riparian	≥ 5 inches	No	1	3:1	3	1:1	3
		Yes	37	6:1	222	2:1	444
Riparian	≥ 1 inch and ≤ 3 inches	No	110	2:1	220	1:1	220
		Yes	25	4:1	100	2:1	200
Riparian	> 3 inches and < 5 inches	No	46	8:1	138	1:1	138
		Yes	10	6:1	60	2:1	120
Riparian	≥ 5 inches	No	27	4:1	108	1:1	108
		Yes	4	8:1	32	2:1	64
Totals			424		1,249[2]		2,021[2]

[1] Information based on the Conservation Guidelines for the Valley Elderberry Longhorn Beetle (Service 1999a).
[2] Plantings require 588,600 square feet or 13.51 acres.

Table B-3. Effects on delta smelt (*Hypomesus transpacificus*) critical habitat in the Southport Early Implementation Project action area of the West Sacramento General Reevaluation Report Project, West Sacramento, Yolo County, California.

Shallow Water Habitat Created	Shallow Water Habitat Affected
118.81 acres	8.49 acres (0.04 permanently)